SCIENTIFIC AMERICAN

The Problem of Our Navy—
VIII. Mobilization and a Naval Reserve

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Price 10 Cents
$3.00 A Year

Chalmers

The Master "Sixes"

Master "Six"
$2175
6-passenger Touring Car, $2275

$10,500,000 Worth of Evidence

The combined salaries of all the Presidents from George Washington to Woodrow Wilson would buy only one-third the Master "Sixes" now in use, $10,500,000 worth. Many of these cars have been driven thousands of miles. 61% of their owners abandoned other cars when they bought Master "Sixes," so they can make comparisons—can speak from experience.

Through these men the fame of the Master "Six" has spread like wild fire. In all sections sales have far outstripped all past records. For unconsciously every Master "Six" owner becomes a Chalmers salesman. Even we did not foresee the nation-wide triumph of the Master "Six," so we will run short at least a thousand cars this season, that's certain.

The Man Who Knows

Men bought Master "Sixes" not upon impulse but upon positive knowledge.

Do as these men did; talk with those who own Master "Sixes." They will tell you first, that the resistless sweep of the "Six" is not founded upon a fad, but upon these logical reasons: silence, smoothness and flexibility. They will tell you that these advantages are so real in the Master "Six" that they are forever spoiled for any other car.

You may still think of a "Six" as necessarily a heavy car, costly to buy and expensive to keep. Once that was true. But that day passed with the coming of the Master "Six."

What Owners Have Found Out

Owners will tell you that it is heavy enough for the utmost in safety and comfort, yet light enough to be easy on tires and frugal with fuel; that the continuous power of its six cylinders has done away with vibration, and so reduces wear and tear almost to nothing.

Former owners of high priced cars have learned that in the Master "Six" they secure the same six-cylinder luxury without the usual six-cylinder expense.

Get the Evidence Yourself

Among the thousands of owners of Master "Sixes," some live in your vicinity. Ask us, or your dealer who these men are. Talk to them. They can give you facts it would be folly to ignore.

Then let our dealer take you on the Chalmers Test Ride. See with your own eyes the beauty of its streamline body. Feel with your own hands the ready response of its supple power. Learn the charm of its luxurious silence and comfort. Then it will be plain why, in half a year, men have paid over ten millions for the Master "Six."

A Master "Light Six"—$1,800

No longer need those who want six-cylinder luxury, hold back on account of the price. Here's the Master "Six" built on a lighter scale; with the same motor but a smaller and lighter model; yet it shows 30 to 50 horse power and has more speed than you'll ever need.

Light for the sake of economy in tires and fuel; yet with a 126″ wheel base for roomy comfort. Graceful in outline, distinguished in appearance; and sold at a price which sweeps away the last reason for doing without a "Six."

A Princely Inheritance

This lighter "Six" has all the features which have made the Master "Six" illustrious.

Its small bore and long stroke motor give it the same flexible power—from a snail's pace to an express train speed without shifting gears.

The steady pull of its six cylinders gives smoothness of motion, resistless in its charm; a smoothness that cuts wear and tear to the vanishing point. Its lighter weight means added economy in fuel and tires; while its price makes it easy for multitudes to own "Sixes."

Strength No Longer Means Weight

Time was when "Sixes" were heavy to secure comfort and the required margin of safety. So now one marvels at the sturdy strength of the Master "Light Six."

This is due to the simplicity of the Chalmers design; to heat-treated steel with a four-fold margin of safety; to aluminum castings; to drop forgings. With its deep upholstery and sinewy underslung springs, excessive weight is no longer essential to comfort and safety.

Its light weight and low price mean a double saving. A lower cost means economy once; lower up-keep cost means economy every day.

Built Up to a Standard, Not Down to a Price

The Master "Light Six" is built throughout to meet a standard, not to fit a price.

We use the best steel because we must hold up the strength while we hold down the weight. Valves of ordinary steel are cheaper, but our valves of Tungsten steel never warp nor waste power. Our molded oval fenders cost more than flat ones, but they pay for themselves in added beauty and utility. Every dollar in the price stands for a dollar of real value in the car.

The Price is Lower—Not the Quality

The selling price of the "Light Six" is lower than the Master "Six" because the cost is less. The horse power is less because the motor is lighter; the weight is less because the car is a bit smaller.

But it has the same Chalmers-Entz one-motion starter; the same non-stallable Master Motor. Its roomy body is the true streamline type with flush fitting doors and concealed hinges. Tires are carried at the rear, leaving the running board clear. Its tapering bonnet, underslung springs and oval fenders give it distinction in any company.

Master "Light Six" Touring Car - $1800
Master "Light Six" Coupélet - - $2050

Fully Equipped f. o. b. Detroit

Chalmers Motor Company. Detroit, Mich.

Chalmers Motor Company, Detroit, Michigan

Send me the names of owners of Master Sixes in my vicinity, also catalog.

Name .....

Street Number .....

City ..... **State** .....

Sci. Am.

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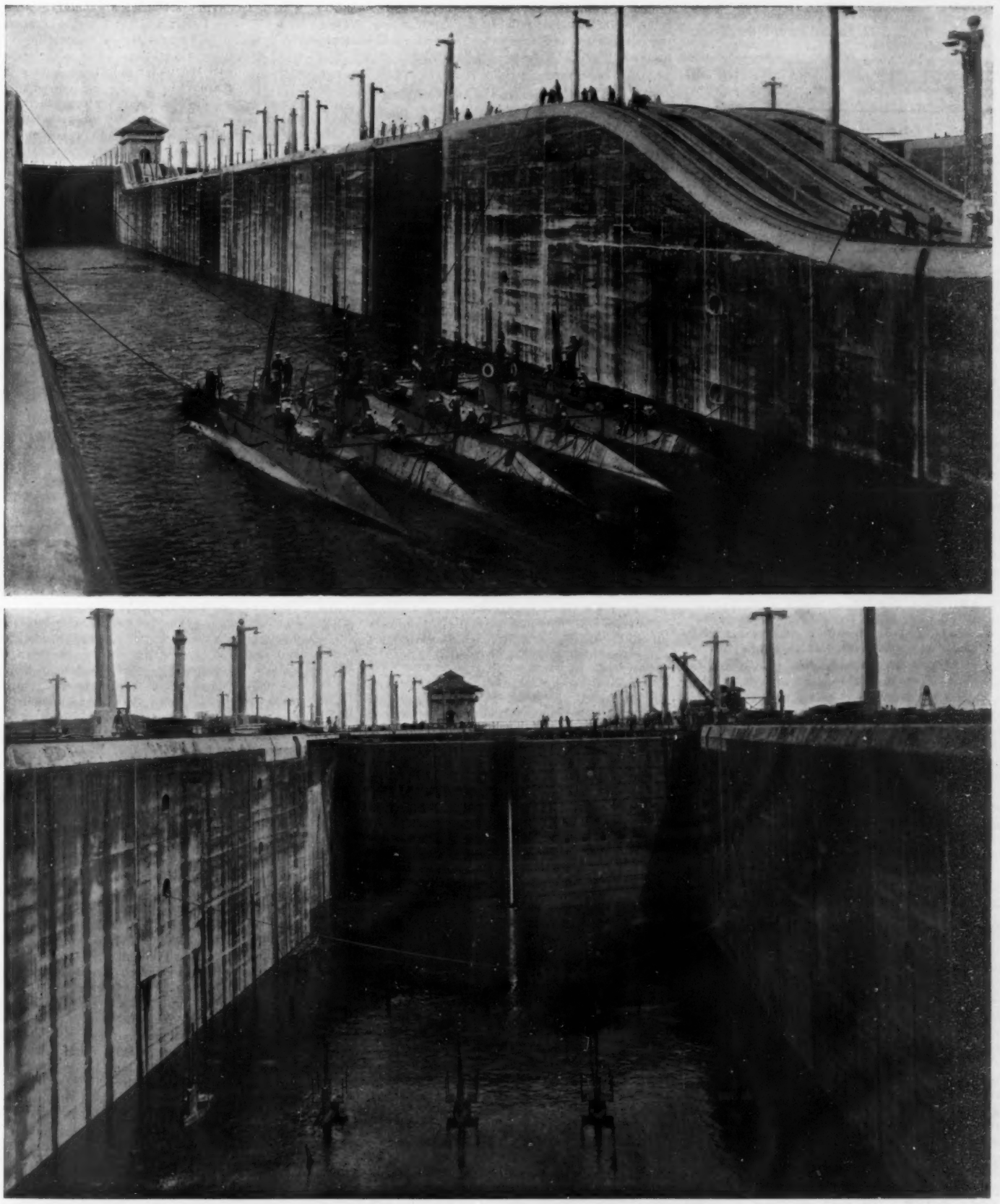

Upper engraving represents submarines entering the lock at Gatun. Lower engraving shows submarines submerged and resting on the cradles.

DRYDOCKING IN PANAMA CANAL LOCKS.—[See page 328.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Ridiculous Proposal

THE country has been favored of late with disconcerting evidence of the ignorance of some members of Congress on the subject of our Navy. Lack of elementary knowledge in such high quarters on matters of grave national import is greatly to be regretted; and when to this is added the fact that there occasionally crops out evidence of an active spirit of hostility, the situation becomes deplorable. It was only recently that a certain Senator spoke contemptuously of service in our Navy as being a condition of "paid idleness"—willful misrepresentation which is as unjust to the honorable profession attacked as it is discreditable to its author.

And now comes Senator Weeks with his amazing proposal to place the fast scout cruisers of the Navy in service as carriers of mail and freight between New York, New Orleans, and the Pacific Coast ports of South America! There is no possible excuse for the introduction on the floor of the Senate of such utterly impracticable proposals as this; for it is a fact, which must be well known to every one of the people's representatives in Congress, that there is within a few minutes' reach of the Capitol at all times a body of expert advisers, not merely in the Navy, but in every other Government department, who are not only willing, but very eager to afford all possible technical information and enlightenment on subjects which the members may wish to bring up for discussion, either in the House or the Senate. If Senator Weeks had taken the trouble to submit his proposal to the technical advisers of the Secretary, he would have been instantly assured that to use naval vessels for the transport of mail and freight was a proposition impossible from every point of view.

In the first place, the transfer of vessels from naval to commercial service would violate one of the very first principles upon which an efficient navy is maintained, namely, that every ship shall be in such a condition of efficiency that, in the sudden crisis of war, it can instantly proceed to the appointed rendezvous in which the mobilized fleet is being assembled. Of all types of naval ships there is none whose service would be more quickly called for than that of the scouts, whose duties would require them to operate far in the van of the fleet, where they could obtain the earliest possible information as to the strength and destination of the enemy's forces.

In these days of watchful preparedness when, as in the case of the German navy, from three fourths to four fifths of the principal units are maintained in full commission and active service, a decisive blow may be struck contemporaneously with the declaration of war, or even in anticipation of it. It has always been a characteristic of our foreign policy, and was never more so than to-day, that we have been reluctant to make any distribution of our military forces which might bear any hostile construction by the nation with whom we were conducting diplomatic exchanges. Our scout service, as we have shown in a recent article, is altogether too limited as it is; and were the only three distinctively scout vessels that we possess to be transferred, as Senator Weeks has suggested, to commercial work, it is perfectly conceivable that a sudden declaration of war might find the "Chester" at Valparaiso, the "Salem" at Buenos Ayres, and the "Birmingham" in the Straits of Magellan.

If Senator Weeks had taken the trouble to inquire, he would have been told that one of the chief difficulties of the naval constructor is to find space for such equipment, stores, berthing accommodations, fuel, etc., as must be carried by a warship in the performance of her designated work. He would have learned that every pound of displacement and every cubic foot of space has been allotted, and that it would be impossible, without making serious changes that would destroy the efficiency of the ship, to find space for mail, freight, passengers or any other of the accommodations which are necessary for the service proposed. Furthermore, the motive power of a fast scout cruiser was not designed to give those economical results which are only to be achieved when a designer is left a free hand to design a ship for the particular commercial service for which it is being built.

Let us hope that this latest absurdity will be consigned to the early oblivion which it deserves. We had thought that puerile suggestions such as this belonged to an earlier day, when ignorance about naval matters, particularly on the technical side, was excusable on the ground of unfamiliarity. To-day, when there is so much reliable information published regarding our Navy, there is no possible excuse to be found for such amateur proposals as this.

The "America" Cup Contest

THE present year will go down in the annals of yacht racing as one of the most famous in the history of this noble sport. The coming again to our shores of the indomitable Lipton, this time with the fourth "Shamrock," has resulted in the construction of three defending yachts, one by the veteran Herreshoff, another by his most able American competitor, Gardner, and a third by one of the most promising of our younger designers, Owens.

Particular interest attaches to this year's series of contests, because of the fact that they will be held under a new rule of measurement, which discourages the building of the extreme and almost freakish type of yacht with which the public was made familiar in the last series of "America" cup contests. The old rule encouraged the construction of a yacht of extreme beam, draught, and over-all length, with a flat floor and full ends, and carrying an enormous spread of sail. The new rule governing this year's contests encourages a return to a more wholesome form, with a fuller and deeper body and sharper ends—a type which, after the races are over, is still serviceable for cruising because of its greater head room and its easier motion in a seaway. Furthermore, the more limited draught enables the yacht to enter harbors and cruise in waters which are inaccessible to the older type. When it is remembered that these manifest advantages are secured without any sacrifice of speed, the all-round advantages of the new rule over the old will be manifest.

In Nicholson, one of the younger designers, the challenger has at his disposal the genius of the most successful yacht designer, probably, in Great Britain. "Shamrock IV" will also have the advantage of being absolutely in charge of the most successful amateur yachtsman to be found in the British Isles.

Mental Acrobatics

THAT perfection in the solving of scientific problems is an art to be acquired by training, practice, and experience is so obvious a truth as to require no emphasis and to invite no contradiction.

Not so obvious is the fact that in the selection of problems for inquiry, in the mere asking of questions, much depends on the judgment and common sense of the inquirer. Indeed, it has been said that the great man in science is recognized not so much by the means he employs to attain his ends, as by the purposes toward which he bends his efforts.

The mind of man is so constituted that it must needs ask questions regarding things and events about him. And this is well; for to this inquisitive streak in his make-up we owe probably all the most fundamental discoveries of science; the other impelling agent, the desire to apply natural forces to useful ends, has probably played a less important rôle in the history of science, and has affected chiefly the development of detailed knowledge rather than the discovery of broad fundamental principles.

Now this impelling desire to "ask questions" has its drawbacks. The case is well illustrated in a simile drawn by the great German physicist, Ludwig Boltzmann. He likens the efforts of certain philosophers to those of a baby sucking at a feeding bottle: So long as there is milk in the bottle the baby sucks with gusto and effect; but presently the bottle is empty: still the baby goes on sucking. So, said Boltzmann, certain types of mind are set upon asking questions, and when they have exhausted all sensible questions in their repertoire, they turn to the consideration of vain and futile inquiries. The middle ages were particularly rich in mental gymnasts of this kind, but our day is not by any means free from acrobats who would essay a tight-rope dance across the chasm that separates us from the region—not of the unknown—but of the unknowable.

One of those vexed "problems," which never ceased to have an irresistible fascination for certain minds, is that of the "ultimate cause" of things.

Now such inquiries as this are a pure waste of energy for two reasons: first, because they can never lead to any solution; and, secondly, because we can accomplish all our daily tasks and affairs perfectly well without waiting for such a solution. In other words, the inquiry is both fruitless in its results, and useless in its applications.

If evidence is needed to substantiate these statements, let the reader reflect over this: If the search after causes were really so vital a function of scientific research, surely we should expect to find the word "cause" to recur somewhat frequently in works presenting the results of the most advanced phases of modern science. As a matter of fact, advanced sciences, like gravitational astronomy, even physics in general, never employ the term "cause." Indeed, the word could well be spared from the scientific vocabulary. "The word 'cause,'" says Bertram Russell in the *Proceedings* of the Aristotelian Society, "is so inextricably bound up with misleading associations as to make its complete extrusion from the philosophical vocabulary desirable. . . . The reason why physics has ceased to look for causes is that, in fact, there are no such things. The law of causality, I believe, like much that passes muster among philosophers, is a relic of a bygone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm."

The fact is, the physicist has not only learnt to answer questions, but to ask them. He spends no futile efforts seeking to find the ultimate cause of an event; but instead, he studies the various *determining factors* which influence a given phenomenon. He measures each factor and the phenomenon studied, and seeks to find an equation or formula by which the one can be calculated when the others are given. In technical language, he seeks to discover the *functional relations* between the variables which appear in his problem. Once this is done, once his formula is found and proved correct by actual test, his task is finished, and any further inquiry after the "cause" of things seems a fit subject for an inmate of an institution very different in character from the physical laboratory.

Industrial Research and the Steel Rail

IN the course of his presidential address before the American Chemical Society, Arthur T. Little, speaking on the question of industrial research in America, showed how the steel industry in its many ramifications promotes an immense amount of research, which ranges from the most refined studies in metallography to experimentations upon the gigantic scale which was required for the development of the Gayley dry blast, the Whiting process for slag cement, or the South Chicago electric furnace. This last is the furnace which has formed the subject of considerable illustration and description in the SCIENTIFIC AMERICAN during the past two years. The president of the American Chemical Society is of the opinion that this furnace has probably operated upon a greater variety of products than any other electric furnace in the world; and he draws attention to the fact that up to the autumn of last year, after two and one half years of operation, no reports of breakages had been received from the 5,600 tons of standard rails made from steel produced in this furnace. That would be a significant statement under any conditions, and it is particularly so when it is borne in mind that, during the past thirty years, the average total weight on the drivers has increased over two hundred and fifty per cent. Thus, in 1885, the average total weight on drivers was 69,000 pounds; in 1907 it had risen to over 180,000 pounds, and in that same year it reached a maximum in a few locomotives of 316,000 pounds. Yet, in spite of this enormous increase in the concentrated load, the weight of rails during that same period had increased only from between sixty-five and seventy-five pounds to between eighty-five and one hundred pounds per yard. In the years preceding the introduction of the electric furnace and the manufacture of steel rails from its output, the breakages were so frequent that they constituted one of the most serious perils, if not the most serious, of railroad travel. Thus, in 1905 conditions were so bad that out of a lot of 10,000 tons, no less than twenty-two per cent were removed during their first year of service because of depression in the head of the rails.

As promoting the safety of railroad travel, the product of the electric furnace may well take rank with the Westinghouse brake, block signaling, automatic stops, and the steel car.

The Exploration of Albania is perhaps the most urgent problem in European geography. A society has been formed in Vienna to promote the investigation of this *terra incognita*, and one of its members, Franz Seiner, of Graz, is about to undertake a preliminary topographic survey of the country, which he hopes to complete in a year.

Electricity

Railroad Wires Underground.—As a result of the recent storm, which tied up railroad service between New York and Philadelphia by blowing down telegraph and telephone poles across the tracks, the Pennsylvania Railroad has decided to run its telegraph, telephone and signal wires in conduits underground.

High Power Transmission.—At present there exists in Europe only one line carrying power at a tension superior to 100,000 volts; this is the 60 kilometer line at 110,000 volts equipped in Silesia by the "Lauchhammer Aktiengesellschaft." In the United States, on the contrary, distributions at high tensions have rapidly developed. There are more than fifteen transmitting current at a pressure higher than 100,000 volts, and over distances greater than 500 miles.

Electric Dock Equipment.—Quite an extensive electric outfit is used at the new docks on the Spree, at Berlin. The docks are well laid out for handling grain, as well as for receiving supplies of benzine in underground tanks, coal, brick and other freight, and the port is connected by tracks with the railroad. No less than 37 electric motors are used for the ten main cranes, while 28 motors serve for various conveyers for the grain docks. Numerous other cranes besides winches and elevators take upward of 20 motors. The whole is a model plant. Some 200 railroad cars are accommodated in the dock quarters, and most of the material is handled by electric devices so as to assure a rapid service.

Alternating Arc in Mercury Vapor.—It has commonly been supposed that it is impossible to maintain an alternating arc in mercury vapor, for low frequencies and moderate voltages. In a paper read at the Paris Academy of Sciences, it was shown that this can be done. The quartz tube is full of mercury and ends in two reservoirs in communication with the atmosphere. Placed in series is a self-induction enabling the short circuit current to be reduced to about 2½ amperes. The arc is started by breaking the column in the middle by causing the mercury to bubble. A true alternating arc is established, the two alternations being separated by a period of extinction of about one thousandth of a second.

German Army Searchlight.—The German army is making use of a type of field electric searchlight which can be raised to quite a distance above the ground by the use of a telescopic tubular pole, this being made in four sections. By means of a hand winch, the tube is extended to the desired height, so that the beam can be directed to advantage. The apparatus is mounted on a two-wheel truck which is coupled to a second truck with driver's seat so as to make a four-wheel wagon. On the ground, the searchlight truck is uncoupled, and set at the proper point. The mast portion is folded down flat against the framework when not in use. Current comes from a dynamo group on a special wagon.

Effect of the Eclipse on Radio-telegraphy.—The British Association for the Advancement of Science has issued a bulletin calling attention to the exceptional opportunities that will be afforded by the total eclipse of the sun on August 21st for studying the effect of light and darkness upon radiotelegraphy. The eclipse will be total along a strip extending from Greenland across Norway, Sweden, Russia and Persia to the mouths of the Indus. In Russia, the duration of totality will be a little more than two minutes. There are two main points calling for investigation during the eclipse. In the first place, the propagation of signal-bearing waves through air in the umbra and penumbra will probably obey laws different as regards absorption and refraction from those obeyed in illuminated air. In the second place, the strength, frequency and character of natural electric waves, and of atmospheric discharges, may vary. To investigate the propagation of signals across the umbra, it will be necessary to arrange for wireless telegraph stations on either side of the central line of the eclipse to transmit signals at intervals while the umbra passes between them. It is thus very desirable that the Scandinavian and Russian stations should transmit frequently throughout several minutes before, during, and after totality. But stations other than those favored by their proximity to the central line should endeavor to keep a complete record of the variations of signals during the eclipse. Stations in Europe west of the central line, and stations in the Mediterranean and in Asia Minor, may find noticeable changes in the strength of signals, particularly long distance signals, between the hours of 10 A. M. and 3 P. M., Greenwich time; and it is probable that the stations of India and East Africa, and ships in the Indian Ocean, may feel the effect of the penumbra in the afternoon. On the other hand, ships in the Atlantic, and fixed stations in Eastern Canada and the United States, will probably be affected by the penumbra in the early morning. At Montreal, the eclipse (partial) is at its greatest phase at 5:52 A. M. Standard Time. It is requested that those possessing the necessary facilities and willing to make observations during the eclipse, communicate with the Hon. Secretary, Dr. W. Eccles, University College, London, W. C., at the earliest possible date.

Science

An Exhibit of Rain-gages.—The British Rainfall Organization is arranging an exhibit in the science section of the forthcoming Anglo-American Exposition, one feature of which will be a collection of rain-gages, of the 1814 period and earlier, which will be placed side by side with the gages used at the present day.

Theodore Roosevelt and the American Museum of Natural History.—It is announced that Theodore Roosevelt will give to the American Museum of Natural History $2,000 when he returns to New York, and that he will assist it in raising $4,000 more to carry out explorations in South America which are to complete the work which he has begun.

Vaporized Tar as a Fuel.—The Indiana Steel Company, at Gary, is using coal tar as a fuel for some of its open-hearth furnaces. The tar is heated till quite fluid, and injected under the boilers with a blast of steam which, of course, atomizes the tar. It burns much like a jet of oil and steam, and is economical, since the Gary plant secures much tar from its by-product coke ovens.

Expedition Shipwrecked on Hudson Bay.—The Norwegian ethnologist Chr. Leden, who was commissioned by the Canadian government to make a study of the Eskimos in northern Canada, and was also making collections for Canadian, German and Norwegian museums, was recently shipwrecked on Hudson Bay, and lost his whole outfit. After suffering great privations, he reached Fort Churchill early in February.

Hardening Steel with Compressed Air.—The usual methods of hardening steel in oil, water and other special baths produce a great tension along the line of contact between the hardened and unhardened parts. A recent German improvement on this process is the use of a number of jets of compressed air playing on the hot steel. The zones of cooling are graduated beautifully by varying the number and spacing of the openings in the nozzle. A wide range of results is possible by adapting the shape of the nozzle to that of the work.

Pharaoh's Serpents.—A cone of mercuric sulphocyanate, when ignited, burns with the development of a tremendous amount of ash. The cone seems to swell and writhe away like a serpent, hence the name. Any boy can make the cones at little expense. To a solution of corrosive sublimate, add a few drops of ferric chloride. Dissolve potassium sulphocyanate in water, and slowly add this to the other solution, until, after stirring, a red color remains. Filter through a sheet of muslin and form the white curds into little balls or cones. Dry, and you need only touch a match to produce Pharaoh's serpents. Do not breathe the vapors.

Treating Yeast with Ozone.—A curious commercial application of ozone has just been developed in the brewing industry. Samples of brewers' yeast treated with ozone for five minutes show greater fermenting power than untreated yeast. During the first day or two, there is no gain, but after that ozonized yeast exhibits fermentative power markedly in excess of untreated yeast. The benefit comes from the inhibitive action of ozone on objectionable organisms, and also because the weaker yeast cells are eliminated and the stronger ones stimulated in fermentative power. In the brewing industry, the over-production of yeast cells is a great source of loss which will doubtless be lessened by ozonization.

The Lost Russian Arctic Expeditions.—The Russian government has at last decided to make a search for the missing expeditions of Sedov, Russanov, and Brussilov, and has bought two Norwegian vessels, the "Hertha" and the "Eclipse," for this purpose. The "Hertha," with a Russian crew, will go in quest of Capt. Sedov's expedition, which is supposed to have sailed last August from the north coast of Nova Zembla for Franz Josef Land, and has not since been heard from. The "Eclipse," with a Norwegian crew, and under the command of the veteran explorer Capt. Otto Sverdrup, will proceed to the Kara Sea in hope of locating the expeditions of Brussilov and Russanov, both of which have been missing since the autumn of 1912. The former set out to attempt the Northeast Passage, while the latter was last heard from when *en route* from Spitzbergen to Nova Zembla. The rescue ships are to sail from Christiania, June 24th.

Capt. Amundsen's North Polar Expedition, which, as originally planned, was to have sailed in the summer of 1913, and was postponed for a year in order to give the scientific staff more time for preliminary studies and training, has now again been postponed for a year; this time because it appears that the "Fram," the vessel in which the expedition is to sail, cannot reach San Francisco in time for an early start from that port. Last year, the little vessel sailed from Buenos Ayres to Colon, in the expectation of proceeding thence via the Panama Canal; on account of the delay in the opening of the latter, this route was finally abandoned, and the "Fram" started on the long journey around the continent in which she is now engaged. The further postponement of the expedition will be turned to advantage, especially in giving the explorers time to become expert in the use of aeroplanes, three of which are to be included in the equipment of the expedition.

Astronomy

The Duration of the Sun.—Adopting the well-known hypothesis of Helmholtz, which attributes the production of the heat emitted by the sun to its contraction, an idea can be formed of the sun's duration. If one gives to the sun a coefficient of expansion intermediate between that of mercury and that of gas, one arrives at the conclusion that it has taken one to three millions of years for the sun to contract to its present radius; in particular, it would have taken 10,000 years to contract from infinity to a radius twice its present radius. Finally, the sun will take 200 millions of years to contract from its present radius to half that radius, and even then its temperature at the surface will be 3,000 degrees.

Earth-Shine on the Moon.—When the sun has disappeared beneath the horizon and we no longer receive its rays direct, it also happens that its light continues to reach us, indirectly and feebly, reflected by the whole or part of the disk of the moon. Inversely, when a portion of the lunar disk is not illuminated directly by the sun, it happens that it is feebly illuminated by the earth-shine; that is to say, by the reflection that those portions of the terrestrial surface which are at that moment exposed to the sun. Mr. F. W. Very has endeavored to determine the brightness of the light received in this way by the moon and has measured the intensity of this light compared with the intensity of those parts of the lunar disk which are illuminated directly by the sun. The result is that the earth-shine on the moon is about 1,600 times feebler than the mean brightness of those portions illuminated by the sun a little before the first quarter.

Distance of the New Star in Gemini.—In the spring of 1912, considerable interest was excited by the sudden appearance of a brilliant star which became visible to the naked eye during some weeks in March and April. After May it was no longer visible except in powerful telescopes. Mr. Slocum has attempted to measure the parallax of this star, and hence to deduce its distance from us. Parallax is a measure of the change of perspective a moving object presents when regarded from two different positions. Advantage is taken of the revolution of the earth in its orbit, and measurements are made at intervals of six months. Mr. Slocum, with the great 40-inch refractor at the Yerkes Observatory, has taken fifteen photographs of the new star at three different periods of six months. Six comparison stars were selected as near the Nova as possible, and distributed approximately symmetrically round it. A discussion of the results shows that the Nova is about 296 light years away, so that the sudden blaze of 1912 corresponded to some catastrophe which occurred in the beginning of the seventeenth century.

Double Stars in a Double Star System.—The two stars Mizar and Alcor form a double star system which can easily be perceived by the naked eye. This was not the case formerly, as the Arabs used the resolution of the system into its two components as a test for good eyes. It would seem, therefore, that this star has increased in brightness since the tenth century, a supposition which is supported by the fact that it is not mentioned by the ancients. The history of this star was familiar to astronomers when it was found, in 1907, that Alcor is itself a double star. It is now discovered, by Mr. Harlow Shapley, that Alcor varies in brightness, the variations having a feeble amplitude and a short period. The spectrum type of Alcor, which is a star A5, that is to say a white star with hydrogen predominating, and the doubling of the lines, announces a variation of the Algol type, i. e., by eclipse, rather than continuous variation. It is supposed that there exists a couple of elliptic stars very close together and inclined on their orbit in such a way that the mutual eclipse is feeble or almost nothing, the variations of brightness resulting from their marked ellipticity.

The Stellar Magnitude of the Sun.—The classification of the stars into orders of magnitude depending on their apparent brightness was undertaken a little hastily, with the result that many stars have been found which are brighter than stars of the first magnitude. Aldebaran is a typical star of the first magnitude, but Sirius is much brighter. Consequently the system of classification has had to be extended. A star of the first magnitude is 2.5 times as bright as a star of the second magnitude; a star of the second magnitude is 2.5 times as bright as a star of the third magnitude and so on. Stars which are 2.5 times as bright as a star of the first magnitude are called stars of 0 magnitude, while stars 2.5 times brighter still are said to be of the —1 magnitude and so on. Prof. Ceraski has made measurements to determine the magnitude of the sun, reckoned in this way. By adopting different methods of measurements, he reaches very accordant results, and it appears that our sun is a star of the —26.5 order of magnitude, which means that it sends us as much light as 880 millions of stars of the first magnitude. At the distance of a little over four light years, i. e., about 29,000 times its present distance, it would be a star of the first magnitude, so that, considered as a star, it is nothing out of the ordinary.

Moving Pictures Without a Screen

A Remarkable Development in Kinematography

By the English Correspondent of the SCIENTIFIC AMERICAN

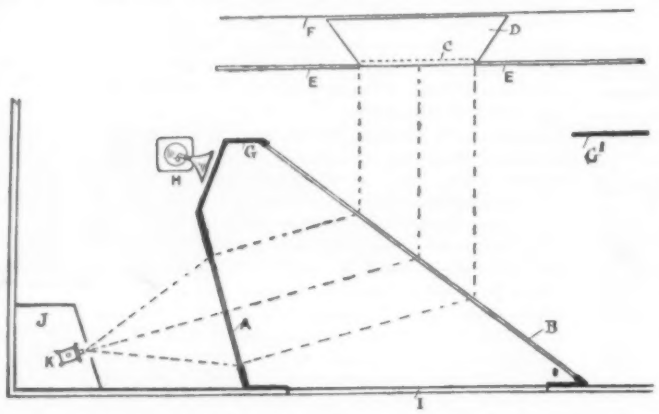
SOME five years ago a German experimenter, Herr Messter, as a result of some particular investigations, discovered that if moving pictures were projected by reflection in a certain manner, the stage could be set with scenery and properties, as for a regular play, with the result that the usual white screen could be eliminated, and that the photographic figures could be moved about within a certain area in such a manner as to convey the illusion that living performers were seen instead of photographic reproductions. He pursued his experiments, but was faced with the initial difficulty that only small figures could be projected, and this fact tended to destroy the illusion, since to maintain the latter, life-size portrayal of the performers was imperative. Another complexity which troubled him was the destruction of the coloring qualities owing to the high light necessary. This latter problem was overcome by utilizing pierrots and clowns, in which only black and white dress and make-up were required. Such a limitation was a handicap, but, nevertheless, when such pictures were shown, considerable interest and wonder as to how the effects were obtained, were aroused. The fact that the figures were dwarfish, and yet apparently endowed with life, enhanced the mysterious effect. By patient experimenting the inventor at last overcame the latter deficiency, and having succeeded in getting his figures life size, public exhibitions of "Alabaster," as it was called, were given in Vienna with great success. The absence of the familiar white screen proved an irresistible attraction. At the Scala Theater in London the pictures, upon their presentation, proved an instantaneous success.

The explanation of the mystery is exceedingly simple. Kinoplastikon is no more nor less than a revival of the famous "Pepper's Ghost" idea, adapted to the kinematograph. Singing and talking effects are obtained by electrically synchronizing a talking machine with the acting.

The accompanying diagram explains exactly how the stage is set out. Some years ago a British kinematograph experimenter ascertained that, if moving pictures are thrown through a translucent screen to be projected finally upon a plate-glass mirror, the pictures stood out with greater definition, softness and plasticity. In this instance a screen formed of a kind of ground glass was placed in front of the projector lens. This is the basis of kinoplastikon.

The projector, instead of being set at right angles to the screen, as is usually the procedure, either in front or behind, is placed in the wings, as shown in the diagram. The picture thrown from the projector strikes the translucent screen *A* and passes through it. Instead of falling finally upon a white sheet it strikes a sheet of plate glass *B*, which is set at an angle of 45 degrees to the proscenium opening, and consequently to the audience seated in the theater. This plate-glass screen virtually occupies the whole of the stage, terminating at either end in side wings, while other wing settings may be introduced as desired. In reality the plate-glass screen *B* acts merely as a reflecting medium to the translucent screen *A*. At the rear of the stage, parallel with the proscenium opening, and consequently also at an angle of 45 degrees to the plate-glass screen *B*, is the rear back-cloth which is of sufficient dimensions to cover the whole of the proscenium opening, as in an ordinary stage setting. At a short distance from the back-cloth special side wings *E* are set, the opening left being coincident with the area occupied upon the plate-glass screen *B* by the image of the film. From *E* to the back-cloth *F* the stage slopes upward at 1 in 20, and constitutes a supplementary floor. When the figures are projected they appear to walk upon this latter at the point indicated by the dotted line *C*.

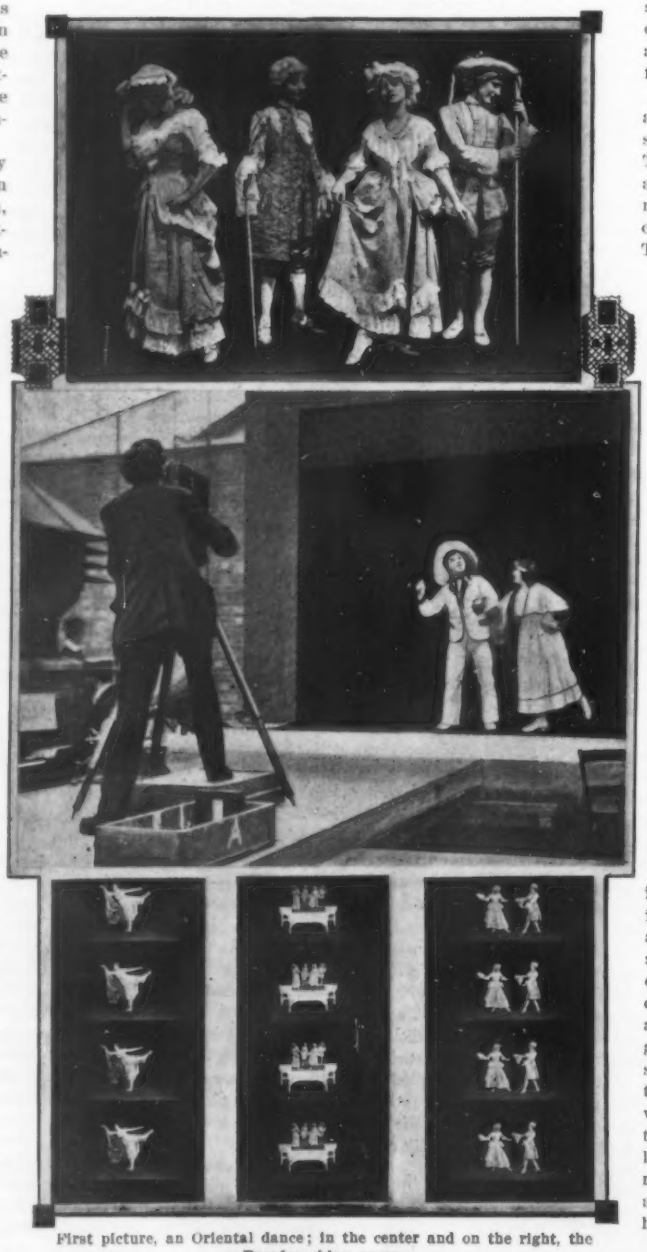
When the pictures are projected they pass from the projector *K* through the translucent screen *A*, and are seen upon plate-glass screen *B*. Here they are bent and apparently, from the audience's point of view, they appear at *C*, although as a matter of fact, it is merely the reflected images upon *B* which are seen. The latter being transparent the pictures appear to stand before the back-cloth *F*, and to all intents and purposes are alive and real players, because when walking off the stage they appear to pass behind the side wings *E* in the true legitimate manner.



I, proscenium opening from the auditorium; *K*, the projecting machine in the fireproof box *J*; *A*, translucent screen set on left-hand side of stage, upon which picture is projected; *B*, plate-glass screen set at angle of 45 degrees to proscenium opening, bisecting clear part of stage, the inner end terminating in scenic wing piece *G*; G^1, opposite wing piece; *F*, back-cloth parallel with proscenium opening; *EE*, scenic wing pieces set to provide opening size of the image thrown upon plate-glass screen *B*, represented by the dotted lines from the bioscope. From *E* to *F* the stage slopes upward at 1 in 20 to form a supplementary stage floor. When the pictures are projected *en silhouette*, as described, upon screen *B*, the feet of the figures appear to be on the stage floor at dotted line *C*.

Setting the stage for "kinoplastikon."

A representation of a Dresden china comedy.



First picture, an Oriental dance; in the center and on the right, the Dresden china group.

Moving pictures without the usual white sheet.

The preparation of the pictures is carried out upon special lines. The studio has a back-cloth of black velvet forming a neutral background, while the figures for the most part are clothed in white, although this latter attribute is not essential in the latest development of the idea. But, as the background is a solid black, the images upon the film stand out against a transparent ground which in projection enables the figures to be *en silhouette* against the back-cloth of the stage setting. The density of the figures upon the film is sufficient to prevent the background from showing through the pictures seen by reflection, so that an apparent ghostly effect is neutralized. The figures in the film stand and move upon a vignetted base corresponding to the floor, and as this blends with the supplementary stage floor *D*, the figures, when projected, appear to stand upon the actual stage. The gramophone is set at *H*, which is as near to the actual apparent position of the players upon the stage as possible without suffering any depreciation in the volume of sound emitted. Were it set behind the side wings *E*, and level with the apparent position of the performers, the sounds would be muffled.

The talking machine and photographic records are not produced simultaneously, as with the Edison kinetophone and the Gaumont chronophone. The gramophone record is made first. Then the artists proceed to the theater, and act the play, repeating the words synchronously with the accompaniment of the previously prepared record. The gramophone is introduced to secure synchrony between lip movement, action, and sound. The operation is one of some delicacy, depending upon careful rehearsal and timing.

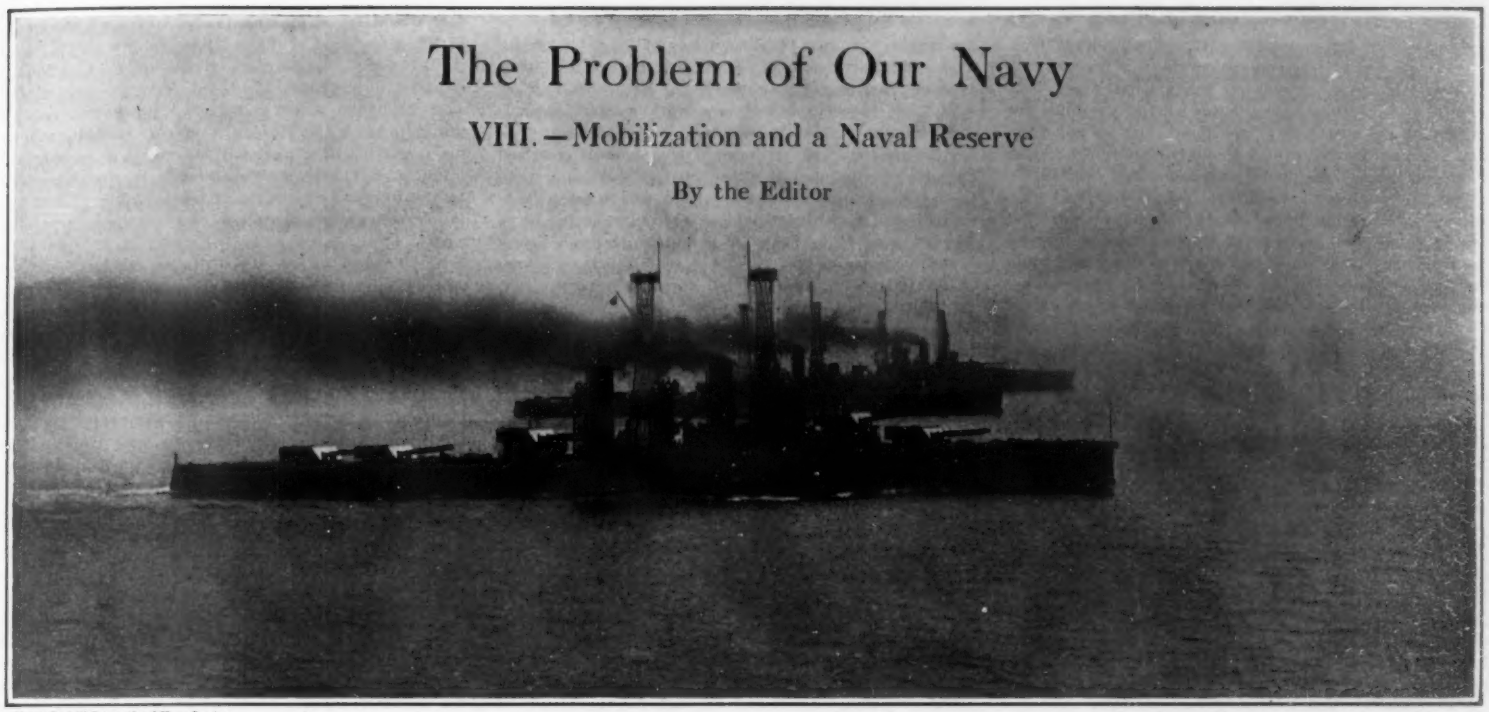
The talking machine system adopted is that known as the "vivaphone," which has proved remarkably successful. In the reproduction, striking coincidence between the action and lip movements of the artists and the talking machine is secured by means of a simple and effective electrical apparatus. In the projecting box is an illuminated indicator having an oscillating hand. The central position corresponds with dead synchrony between sound and movement. As the electrical apparatus of the gramophone is connected with the projector, the operator strives to keep this moving hand in the central position. On one side of the "synchrony" mark is a red light corresponding to "too slow," i. e., the pictures are in advance of the sound; while on the opposite side is a green light indicating action being behind the sound. If the former happens the operator decreases the handle turning speed, while in the latter instance the projector is accelerated. The indicator being in the projecting box, immediately before the operator, the latter has no need to watch the screen to see if he is keeping step. He merely follows the indicator. As in the majority of cases the projector is operated by electricity, the task of maintaining synchrony is exceedingly simple. This method of reproducing sound and movement simultaneously has proved the simplest, most effective, and most economical yet devised. After the gramophone record has been obtained, and should anything go wrong with the acting of the scene, or revisions appear essential, the wastage concerns the film only, whereas if the two different records are produced simultaneously, as in the Edison and Gaumont methods, a mishap, either in recording sound or movement, affects both issues, with the result that both have to be done again.

One very noticeable effect of this method of projection is the absence of flicker. The translucent screen appears to absorb all defects.

The Problem of Our Navy

VIII.—Mobilization and a Naval Reserve

By the Editor



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MODERN wars begin with all the surprise and violent shock of an explosion of dynamite—as witness the night attack by the Japanese destroyers at Port Arthur, which, even before the declaration of war, placed the Russian Pacific fleet out of commission and gave to Japan the command of the sea.

The striking of the first telling blow and the ability to follow it up are possible only when the belligerent, having set in motion a carefully prepared plan of mobilization, is able swiftly to concentrate the whole of his naval and military forces in the theater of war—as witness the fact that following immediately upon the Port Arthur attack, Japan transported to the mainland an army of 100,000 men in four days time.

Had Japan followed our own policy of unpreparedness, had she possessed no plan of mobilization, that is to say, had she left the work of organizing an auxiliary fleet to be done after war was actually upon her, as we did in the Spanish war, months of valuable time would have been lost, Russia would have been able to concentrate an overwhelming army in Korea and Manchuria, and the defeat of Japan would have been inevitable.

Mobilization is defined in the Dictionnaire Militaire as "the passage from a peace to a war footing, the period during which a 'navy' should be provided with everything which is necessary for it to go into a campaign and at once begin active operations."

The same authority goes on to say: "It is naturally important that this period should be as short as possible, for upon its efficient and complete achievement often depends the fate of the first encounters. Therefore, each nation has spared no pains to foresee in all their details the complex operations necessary to be carried out during this period of transition, so that when the time arrives, they may be executed without disorder, omissions or loss of time."

Have we any such elaborate system of mobilization?

The last attempted mobilization occurred in the North River, New York, in October, 1911, when there were assembled no less than 127 ships, including 31 battleships—an imposing array of naval *materiel*, which, if the individual ships had been fully manned and provisioned, and replete with full supplies of coal and ammunition, and if the fleet as a whole had included all the auxiliaries necessary to enable it to keep the sea, would have been a most formidable fighting force.

But what were the facts?

1. The ships in full commission were more or less depleted, both of officers and men, in order to furnish trained men to assist in handling the ships that were temporarily commissioned for the review.

2. The ships sent to the review from the reserve were temporarily commissioned with skeleton crews, sufficient only for purposes of navigation.

3. The fleet included ships that were under repair, and new ships that were completing at a navy yard, which were towed by tugs to the North River and anchored there.

4. The grossly misleading impression of naval preparedness afforded by this so-called mobilization was not chargeable to an absolute lack of preparation; for the work of getting up this show of October was begun in the preceding July and August.

5. *The responsibility for this farce was not chargeable to the officers of the Navy. It was a political move, both in its conception and in its intended effect, and as such, it points with an unerring finger to the underlying cause of the present inadequacy of our Navy as regards materiel, personnel, and organization.*

6. The misleading character of that so-called mobilization was understood and greatly deplored by the officers of the ships assembled, as the following extract from a letter from an officer on the staff of one of the fleets will show: "We are busy preparing for the mobilization in October, and it takes considerable juggling to get enough men in the different ratings for the various ships. In fact, it looks as if we might have to leave one or two behind. We haven't yet managed to straighten matters out, though I dare say we will be able to pull through somehow. But the ships will have very slender crews—not enough to clean them; just enough to take them there and back."

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Rear-Admiral Badger, Commander-in-Chief of the Atlantic Fleet.

Such was our mobilization only so recently as 1911.

But how is it with the other naval powers? We have noted above the efficiency of the Japanese mobilization; now let us consider briefly two other countries which are fully alive to the necessity of a plan of mobilization that is capable of swift execution—England and Germany.

As regards the British fleet the procedure is as follows: From the Admiralty, London, a single telegram, consisting of the single word "Mobilize," is sent to each of four leading naval ports. This sets in motion the entire machinery of mobilization in all its details. These details are specified in complete mobilization plans, and in orders that define the duties of everyone concerned, whether with the military ships, auxiliaries, transports, colliers, supply ships, ammunition ships, etc. *So perfect is the mobilization system that all the fighting ships of the British Navy can be sent, in twenty-four hours time and without any previous notice, to the mobilization rendezvous, manned with regularly enlisted trained men, and fully provisioned and equipped.*

There is no question as to the thoroughness of the German mobilization plans; for it is known that *the German torpedo flotilla can put to sea in two hours, fully prepared for war; the regularly commissioned battleships and cruisers in six hours; and the reserve ships not very long afterward.* No officer or enlisted man of the ships in commission is beyond the reach of recall within the time limit.

Mobilization, to become efficient, presupposes certain concomitant conditions, in all of which we are deficient, and in many of them unbelievably so. Chief among these are the following:

I. *War Plans.* Less than eighteen months ago, one of the most able and progressive officers of our Navy said: "When war becomes imminent, the question which must necessarily suggest itself is: 'What shall we have to do? What is the general plan of operations?' This must be the basis of mobilization and of all other preparations for war. It is a grave statement to make, but it is a fact that war in the immediate future would find us without a single adequate plan of campaign against any first-class power."

II. *Personnel.* A personnel sufficient in numbers to man the reserve ships and the auxiliaries, hastily recruited, but largely untrained, would render defeat probable. We have made no provision, adequate either in numbers or efficiency, for manning even the few fighting ships in reserve, not to mention the auxiliaries. Such increase as we might make would be mustered too late to be of use in the opening critical stages of the war against a well prepared enemy.

We deal with this subject in detail later in this article.

III. *Ammunition, Supplies, and Provisions.* In a previous article we have shown how deplorably deficient we are in torpedoes and mines, having only about one round of torpedoes per tube and an even greater deficiency in mines and mining outfits. To realize the full efficiency of a mobilization there should be on hand a

large reserve of supplies and provisions, coal, etc., and full provision for maintaining the supply either from Government or private sources, as the war proceeded.

Auxiliary Ships. Absolutely fundamental to any successful mobilization, is the listing of and provision for equipping the vast fleet of auxiliary ships, drawn from the merchant marine, which would be required to render the operations of the fighting fleet effective.

Foreign maritime nations list and inspect their merchant ships, assign their service in case of war, list the personnel and maintain the lists corrected to date, contract with the owners for chartering the ships, and in time of peace prepare the plans and material for their quick conversion for war purposes.

We are only now beginning to do this enormous work. It should be prosecuted with all dispatch, and Congress, so far as it lies in its power, should render every legislative aid and encouragement that it can.

Did we find ourselves suddenly at war with Japan, it would require two infantry divisions, totaling 40,000 men and 17,000 animals, to hold our possessions in the Pacific. This would call for over 100 vessels of nearly 350,000 gross tons for transport. Not one half of that number of vessels are available to-day in the Pacific that are suitable as transports. Our transport service would furnish only 50,000 tons. This would be the condition as regards the army; and the auxiliaries for army transport would have to be found after the naval auxiliaries, which in the nature of things would have the first call, had been taken up.

And this suggests the pressing need (for adequate naval warfare) of a large merchant marine.

But that is another story.

Naval Stations and Bases. The prompt equipment and supply of naval bases is a vital element in preparation for war, and a mobilization plan should provide for the rapid accumulation and transport of all necessary material. As matters now stand, we have not the stations and bases that our naval policy requires, nor the reserve supply of equipment, stores, and supplies to render them immediately useful in case of war.

Advance Base Outfits. In the second chapter of this series we drew attention to the fact that in Culebra (off the Porto Rico coast) and Guantanamo in the Atlantic, and in Hawaii, Unalaska, Samoa, and Guam, in the Pacific, we are in possession of a series of valuable strategic bases or outposts, the capture of which would be one of the very first objects of the enemy at the outbreak of hostilities. Our Naval Board has long recognized the importance of having a trained personnel in readiness to embark for these bases immediately upon a serious threat of war. We have the Marine Corps; but we should have on hand the advance base outfits; and the merchant vessels, suitable to serve as transports, should be listed and arrangements for their conversion into transports, etc., should be made beforehand. A few hours delay might mean the loss of an important base of operations.

The Need of a Trained Naval Reserve.

A successful plan of mobilization presupposes for its effective execution a numerous and well-trained naval reserve. Instantly to expand the nucleus crews of the ships in reserve to their full commissioned strength, to man the large fleet of auxiliaries, and to maintain on the receiving ships at the various yards a numerous reserve from which quickly to make good the wastage of war, would call for about double the number of men that are now by law allowed. The authorized enlisted strength of the Navy in time of peace is 51,500 men. Where, in the event of war, would the nation obtain the other 50,000? As matters now stand there would be two sources of supply: the Naval Militia and enlistment. The former represents a grand total of 7,817 officers and men, or about one sixth of the increase which would be instantly required. The other 43,000 would have to be secured by enlistment, a process which, taken in connection with the work of assembling and distributing the men, would consume many weeks of precious time and would involve delays in getting ships into commission that might well be fatal to success.

Our Naval Militia. As far back as the year 1888, the Government realized its need for an auxiliary force which might be drawn upon in the event of war, and in that year there was prepared the first naval militia bill, which failed to pass. The States, however, took independent action and organized Naval Militia forces, which, at the time of the Spanish-American war, represented a total of 4,445 officers and men, of whom, during the war, 4,000 officers and men were added to the Navy by enlistment. Most efficient work was done by the Naval Militia during that war; indeed, the "Yankee," "Dixie," "Prairie," and "Yosemite," if we except the commanding, executive, and navigating officers, were entirely officered and manned by the Militia. Since that time the Naval Militia has steadily increased in strength and efficiency, until it has reached a grand total of 7,817 officers and men, as mentioned above.

On February 16th, 1914, a Naval Militia act was passed which, according to Secretary Daniels, will do more, probably, for the encouragement of this arm of the service than any previous action of the Government. The leading provisions of the bill are that the President is authorized to call upon the Naval Militia in event of war; that the officers and men shall muster into service without further appointment or enlistment; that the Militia, when called into service, shall be governed by navy regulations; that the officers and men, when in service, shall receive the same pay as the same grade in the regular service; that the Secretary of the Navy is authorized to purchase or manufacture arms, accessories, equipment, etc., for the Naval Militia, the sum of $200,000 being appropriated for this purpose; that the Militia shall participate in cruises, maneuvers, etc., of the regular navy; that each State Naval Militia shall have at least five days for military or naval exercises each year; and that ammunition for target practice shall be furnished at the discretion of the Secretary of the Navy, the firing to be done under the direction of an officer detailed by the Secretary.

Much practical experience has been gained by the Naval Militia through the use of naval vessels loaned to the several States, and twenty-nine of these are now in use, the average cruise for which is thirty days each year. According to the Chief of the Bureau of Navigation, there is need for more ships. The vessels are old and many are withdrawn each year on account of age and for ever-recurring repairs. The Bureau believes that a type of ship of the size most suited for the Naval Militia requirements should be constructed to replace the vessels withdrawn.

This recommendation and all such for the benefit of this organization should receive the sympathetic consideration of Congress. It is eminently consistent with the spirit of the country that this body of patriotic, enthusiastic and efficient citizen-sailors should receive every assistance that can legitimately be rendered.

The Source of a Trained Naval Reserve.

While the efficiency of the Naval Militia is admitted, we have shown that its numbers are too small and its training is necessarily too limited, to enable it to provide that numerous and trained body of men which will be needed instantly at the outbreak of war. In such a crisis, the country would have to rely upon the ex-enlisted men of the Navy, who after four years of service, have passed out of the Navy into civil life. Now, while undoubtedly many ex-service men would instantly enlist at the beginning of war, much unavoidable and costly delay in manning the ships would be avoided if these men had been enrolled, organized, and assigned to their ships beforehand. These desirable conditions would be met if Congress authorized the formation of a naval reserve, the members of which would be required to put in three or four weeks of service at sea each year at full pay. As a further inducement, they might be paid, say, $5 per month during their term of enlistment.

Every year, about seven thousand thoroughly trained men, having completed their term of enlistment, are honorably discharged from the Navy and are merged and lost in the civil life from which they came. Among these are skilled gun pointers (worth, according to Capt. Plunkett, about $25,000 per man) quarter-masters, signal men, electricians, machinists, engineers, etc., all of them thoroughly familiar with the routine of ship life, men who, the moment they stepped aboard ship, would drop into the old routine with quick precision.

It is believed that the great majority of these men would welcome the opportunity to enlist in a Naval Reserve, and that the patriotism of the employers would find ways and means for excusing them for the annual period of drill. Such an arrangement, of course, would entail additional appropriations by Congress; but we can conceive of no direction in which the public moneys could be laid out to better advantage than this. There is every reason to believe that, by this measure, a thoroughly trained force, familiar with naval discipline and inured to the sea, would be quickly enrolled. If so, the Navy would have at all times within easy reach a sufficient force of trained men to complete the full complements of the fighting ships which are now held in reserve, in ordinary, or that are out of commission undergoing repairs.

Under the British system each man is assigned to a particular ship, and he knows to which navy yard to report upon notification. When the telegraphic term "Mobilize" has been sent out from the Admiralty and repeated throughout the kingdom, each postmaster, having the address of the various naval reserve men in his village, town, or district, instantly communicates with him. The man proceeds to the nearest railway station, where the ticket agent, upon identification, furnishes him his ticket and a prescribed amount of spending money to enable him to take the first train to the seacoast. The institution of some such method would enable our Navy Department, at the threat of war, quickly to gather all the needed reserves at the various receiving stations and distribute them aboard their several ships. Under such a system the whole of our fleet would be on its way to the appointed rendezvous within a few days of the order to mobilize.

Within the last year, the Bureau of Navigation has established an Office of Naval Reserve, and already over 2,600 men have volunteered for enrollment. In the opinion of the Bureau, Congress should authorize the formation of a National Reserve in a manner that would make the proposition attractive. If it should do so, the Bureau believes that there would be no difficulty in recruiting the full quota required in a very short time.

The Seamen of the Great Lakes. It has been suggested that a fruitful source of supply for the manning of our ships might be found in the seamen of the Great Lakes. During several months of the winter the Lake ports are closed and some 15,000 trained seamen are thrown out of work. It is believed that if Congress authorized a short term of enlistment, covering the winter months, a large proportion of these men, being absolutely without employment, would jump at the chance to enlist in the Navy. This body of men, being used to the seaman's life in deep water, would afford excellent material for the enlisted service. Sufficient men would be secured, probably, to man the reserve ships, which could proceed with the active fleet to the south coast of Cuba for the regular winter cruise, target practice, and drills.

Now it is believed that many of these men would remain in the Navy; and those that returned in the spring to the merchant service would probably wish to be enrolled in the Naval Reserve. In any case the country would be greatly benefited by thus interesting this body of practical seamen in the Navy, and enrolling, as it undoubtedly would, a large proportion of the 15,000 men in its trained Naval Reserve.

Drydocking in Canal Locks

By C. W. Fisher, Naval Constructor, United States Navy

ON December 12th, 1913, five submarines of the United States Navy with their mother ship or tender, the "Severn," arrived at Cristobal, Canal Zone. These boats are known as "C-1," "C-2," "C-3," "C-4," and "C-5." They were tied up alongside their mother ship, upon which the crews and officers live and mess, at one of the new concrete piers built by the Panama Railroad Company. This unique flotilla attracted great interest on account of its peculiar appearance, and its daily exercises in the harbor of Colon, where the small boats dived and maneuvered.

After four months of this duty it was found necessary to place the five submarines in drydock for the usual overhauling, testing and cleaning bottoms from the accumulation of barnacles and other marine growth. The small drydock at Mount Hope, near Cristobal, which was built many years ago by the French, and which is supposed to serve for all docking purposes until the big docks now under construction at Balboa are completed, about eighteen months hence, was unfortunately not available, on account of its being in constant use repairing the dredges at work on the big slide at Culebra. It was, therefore, necessary to devise some other scheme for docking these vessels, and it was decided to utilize one of the great locks at Gatun for this purpose.

Accordingly, on March 8th, 1914, the old "Severn," well known to many a midshipman, having served for years as a practice ship for the Naval Academy, now divested of her sails and machinery, was towed up to Gatun, accompanied by the five little submarines under their own power.

When the interesting fact became known that the very first navy vessel of any nation was about to pass through the locks of the Panama Canal and to enter Gatun Lake, large numbers of spectators gathered upon the walls of Gatun locks to witness this event, and on March 8th, 1914, the "Severn" was locked through and tied up to the approach wall of the Gatun locks in Gatun Lake, thus recording an important event in the history of the Panama Canal. On the following morning, March 9th, the submarines were locked through the east locks of Gatun and drydocked in the upper chamber.

These boats are cigar-shaped, and in order to land them successfully on the floor of the dock it was necessary to construct a cradle for each boat. These cradles were made in sections, of the exact shape of the underwater bodies of the submarines. The canal locks are not designed for use as drydocks, and, therefore, means had to be provided for holding the wooden blocking and cradles down on the bottom of the lock chamber to prevent their floating away when the chamber was filled with water. This was accomplished by bolting the sections to cross timbers placed in the culverts in the floor of the lock through which the water is admitted.

The walls of this lock chamber are 85 feet high, and vertical, and in order to accomplish the work of building the cradles it was necessary to build a staircase 85 feet high, securely tied to the lock walls, in order to

provide access for the workmen and crews of the boats. These preparations took about two weeks. All being in readiness, the five boats proceeded under their own power through the locks into the docking chamber, which had been previously filled with water. Here they were separated the proper distance, so that each might land exactly upon its own cradle, and the bows and sterns held by lines against vertical posts or battens to aid in centering them. The lines holding the bows and sterns to these battens were tended by members of the submarines' crews. Since the extreme bow and stern of a submarine is about three feet under water, these men were dressed in bathing suits while performing this duty.

The five boats being accurately centered over their cradles, the valves were opened and the water slowly removed from the lock. As each boat settled in its particular cradle, much enthusiasm was expressed by the crowds of spectators. When the lock had been completely drained, an examination showed the landing to be successful, and the work of cleaning and overhauling proceeded.

In the midst of the work of overhauling the submarines an emergency arose requiring the docking of another vessel in this same lock. An explosion had occurred the night of the 11th instant in one of the oil tanks on the large ladder dredge "Corozal," which had been working in removing Cucuracha slide. This explosion did considerable damage to the bottom of the "Corozal," and drydocking in order to effect repairs was necessary. The "Corozal" drawing too much water to enter the drydock at Mount Hope, it was, therefore, imperative that she be docked in the other half of the chamber already occupied by the submarines. Similar blocking to that prepared for the submarines was at once installed for the "Corozal," the work being prosecuted day and night, and in four days the blocking was ready. She was docked on March 19th, 1914.

Owing to the fact that the same chamber as that occupied by the submarines was to be used, it was necessary to make some arrangement by which the submarines should not be disturbed when docking the "Corozal." The ordinary method in such cases is to float the ship already in dock and then land both ships at the same time. This, however, requires a large number of men to adjust the vessels accurately over their blockings or cradles; and it was here that the peculiar characteristics of the submarines were utilized to save time and money. Instead of floating these vessels, their tanks were filled, and they otherwise prepared themselves just as though they were to make a dive, so that when the water was let into the lock they remained securely upon their cradles, while the "Corozal" was being pulled into position over her own docking blocks.

Full crews and the commanding officers were on board each submarine, and as the water slowly rose in the lock they one by one disappeared through the conning tower hatch at the top of the boat, and took their stations below, until no one was left outside except the captain. When the water was close to the top of the boat, each captain in turn quickly entered the boat, pulled down the hatch, and as the water continued to rise, the boats were completely covered.

After the "Corozal" had been centered, the valves were again opened and the water removed from the chamber and the lock drained dry, and work at once begun upon repairing the damage caused by the explosion. This second docking in Gatun locks also brought out numerous spectators, because aside from the unexpected and unusual use of the lock chamber, the "Corozal" was one of the most important dredges working on the Cucuracha slide at Culebra.

While these two dockings were the result of necessity, as stated, and while the locks are not designed for such work, the results of these two experiences proved them fully capable of such use in addition to their designed functions as locks. And this means that in case of severe damage to any of the merchant marine or the United States Navy, these locks could be used as additional drydocks, if those to be constructed at Balboa were in use at the time.

So far as is known, this is the first time that submarine vessels have been submerged in such a way. The use of one of the lock chambers for drydocking in no way hampered the operation of the canal, since the west locks remained available for traffic in both directions.

The Problem of Three Bodies Solved

THE outward simplicity of a mathematical problem is often deceiving. To one unfamiliar with the history of the case, it might be a matter of some surprise to be told that the greatest mathematicians had been baffled by that "simple" problem: To determine the path of three bodies acting upon each other according to the Newtonian law of gravitation, given their initial positions and velocities.

The corresponding problem for two bodies is simple enough; their motion can always be represented by a path having the form of one of the conic sections—an ellipse, parabola or hyperbola—with one of the two bodies situated at the focus, and the other traveling along the conic.

But as soon as a third body is added the problem is so increased in difficulty, that in the list of men who grappled with it unsuccessfully we find the names of practically all the greatest mathematicians since Newton, himself included. Euler, Lagrange, Laplace, Poisson, Gauss, Jacoby, Cauchy, Weierstrass, Poincaré, and Darwin all tested their powers on the task.

It has been reserved for a Finnish mathematician, Karl F. Sundmann, to furnish the long sought general solution (a number of particular solutions for special cases were known). The problem is a highly technical one, and it would be fruitless to attempt to explain in simple language the difficulties encountered and now successfully met in its solution. The artifice employed by Sundmann consists in the introduction of a new variable w in place of the time. The co-ordinates of the three bodies and the time can then be expressed as power series in w, which converges for all real values of the time.

From the point of view of mathematical theory the problem is, then, solved. But unfortunately, from a practical point of view, the solution is not satisfactory. It is not sufficiently transparent, does not readily answer the questions which the astronomer asks regarding the properties of the motion of the three bodies. The work of the mathematician in this field, though greatly advanced by Sundmann, is, therefore, not completed. No doubt others will follow along the lines which he has laid down, and, in fact, even now we can report a further advance, inasmuch as G. Armellini has extended the treatment to the case of n bodies.

Aviation in the British Army

AN important statement was made by Col. Seely recently with regard to the progress of aviation in the British army.

The present position of Great Britain may be summarized as follows:

1. The army has transferred its airships—there never were many—to the navy.

2. The army, in future, will concentrate on aeroplanes, which are being improved every day.

How many, then, of these all-necessary aeroplanes are possessed by the British army? The answer is 161, of which 100 were added during the last twelve months. There are to be eight squadrons, complete in men and machines, by the end of the coming financial year, and the total number required will be 250—50 for the Central Flying School, and 200 for the eight squadrons, twenty-five to each. But, as Col. Seely frankly admitted, if you want ten machines to be ready at a given moment, you must have twenty to draw on. Each aeroplane, in a word, must have a spare machine as its fellow, and the two can only count as one, so delicate are these machines, with so many things to go wrong and to give way.

Col. Seely also stated that he was providing for a large increase in the provision of spare parts, and for the creation of an Inspection Department. He spoke of his anxiety to do anything to lessen the risk of flying, and surprised the House of Commons by saying that there had only been six days in the year—barring Saturdays and Sundays—on which there had been no army flights; that there had not been a fatal accident to officer or man belonging to the military wing proper; and not a single breakage of any main part in the air.

The newest aeroplanes have an average speed of from sixty to sixty-six miles an hour.

The Current Supplement

IN this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT L. D. Allen writes on the manufacture and use of bearing metals.—E. E. Fournier d'Albe in an article "The Radiation Problem" gives a general survey of modern theories of radiation, with special reference to the "quantum" or "atomic" theory of light energy.—J. Whitman Bailey contributes an article entitled "A Comparison of Rivers."—The special organs by which animals are enabled to maintain their equilibrium and sense of the vertical direction form the subject of an article by W. Baunacke.—In an article on the wastefulness of coke ovens H. J. Freyn shows, among other things, how such ovens can advantageously be worked in conjunction with blast furnaces.—A profusely illustrated article is devoted to the remarkable work of Prof. Lehmann on liquid crystals, which, as our readers may recall, in many respects resemble living organisms.—The cost of electricity at the source is investigated by H. M. Hobart.—Prof. B. Hopkinson writes on the effects of the detonation of guncotton.—"Some Recent Advances in Piezochemistry" is the title of an article on chemical actions at high pressure by Prof. A. W. Browne.—The causes of accidents with airships are discussed by E. Forlanini.

Correspondence

[The editors are not responsible for statements made in the correspondence columns. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Largest Fossil Bird Known

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of March 21st, 1914, you published an article of mine under the title "The Biggest Bird that Ever Lived." The title which I gave the article was "The Largest Fossil Bird Known." I call your attention to this difference in titles because I do not wish to assume the responsibility of calling the extinct bird that I described "The Biggest Bird that Ever Lived." R. W. SCHUFELDT.

Washington, D. C.

Increasing Motor Output

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of March 14th, 1914, page 227, you published, under the heading "Electricity," a note calling attention to a method to increase the amount of power which a given electric motor can be called upon to furnish, and you attribute the method described to Messrs. Brown, Boveri & Co.

Permit us to state that the invention in question must be credited to Maurice Leblanc, and that it is covered in the United States in particular by two patents, 815,356 and 815,357, granted March 20th, 1906. These patents were assigned to Mr. Westinghouse.

Messrs. Brown, Boveri & Co. are our licensees.

SOCIÉTÉ ANONYME WESTINGHOUSE.

Scientific Photographs Wanted for the Royal Photographic Society Exhibition

To the Editor of the SCIENTIFIC AMERICAN:

The Royal Photographic Society of Great Britain is holding its fifty-ninth annual exhibition in August and September of this year. This is the most representative exhibition of photographic work in the world, and the Society is anxious to make it more international in character. It is very desirable that American scientific photography should be fully represented at the exhibition, and in order to enable this to be done with less work to the exhibitor, I have arranged to collect and forward American work intended for the scientific section.

This work should consist of prints showing the use of photography for scientific purposes, and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than Friday, July 10th. They should be mounted, but not framed.

I should be glad if any worker who is able to send photographs will communicate with me as soon as possible so that I might arrange for the receiving and entry of the exhibit. C. E. KENNETH MEES.

Research Laboratory, Kodak Park, Rochester, N. Y.

Relative Cost of Tunnels and Bridges

To the Editor of the SCIENTIFIC AMERICAN:

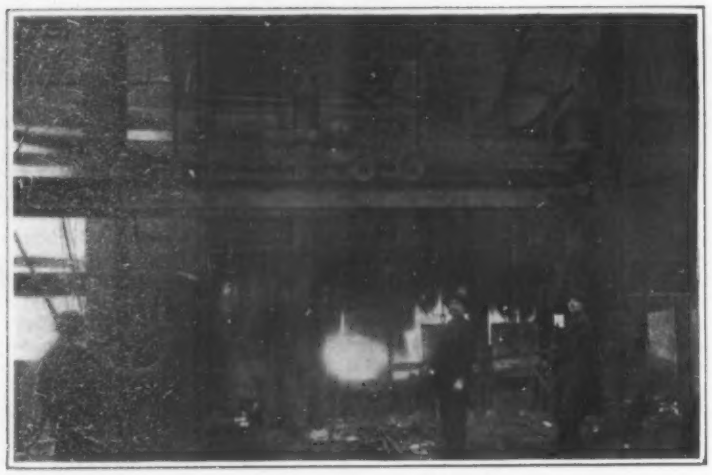
The paragraph headed "Tunnels Versus Bridges" in the issue of March 28th, gives an erroneous impression while purporting to correct one. It considers the "capacity for a given cost" of a bridge and of a tunnel as proposed for the North River, and states what would doubtless be true, that "a bridge would accommodate five or six times as much traffic as could be sent through a tunnel," but it omits to state the equally important fact that the bridge is estimated to cost about five or six times as much as a *pair* of tunnels. Moreover, with a bridge this great carrying capacity is concentrated at one point, so that if it is to be used to its full capacity much of the traffic would have to make long journeys in order to reach the bridge, and again in order to reach its destination after crossing it. On the other hand, the several pairs of tunnels (one for traffic in each direction), which could be built for the cost of one bridge, would be distributed along the river so that the traffic could, in the average, pursue much more direct routes between the points of origin and destination.

I call these facts to your attention, believing that you always desire to be fair to both sides of every question.

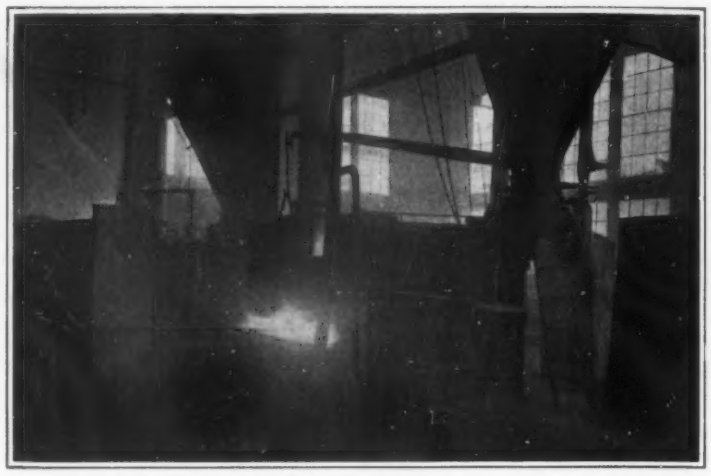
Media, Pa. JOHN LODGE.

[A North River bridge, costing $76,000,000, would have a capacity equal to that of nine pairs of tunnels costing, at $20,000,000 per pair, $180,000,000. Hence, the cost per single track would be two and one half times as much for eighteen single tunnels as it would be for a bridge of equal capacity.—EDITOR.]

It is predicted that western yellow pine will furnish an excellent source of turpentine as the southern pine becomes exhausted.



Forge furnace heating heavy work for the hammer.



Forge furnace burning a blast of coal dust. A great saving of fuel.

Powdered Coal for Fuel

Burning Coal Dust in Jets Like Oil

By Harry N. Holmes

THE use of powdered coal as a fuel has been developed to successful practice. It possesses all the advantages of burning an oil spray and the additional one of greater economy. Like oil, it is blown into the combustion chamber intimately mixed with a blast of air and is there completely burned with little or no smoke.

The comparison of values is interesting. Assuming that there are 19,000 British thermal units in a pound of oil and an average of 13,500 British thermal units in a pound of bituminous coal, and that gas producers will give 85 per cent efficiency, the following values are deduced: Oil at 4¾ cents per gallon, 28,600 British thermal units for 1 cent; producer gas from coal at $3.10 per ton, 69,673 British thermal units for 1 cent; powdered coal, slack, at $2.75, 98,181 British thermal units for 1 cent.

To further this economy in operation a minimum of attention is required, for the best equipment is almost automatic in many details. Oil stoking requires little attention, and the two operations are similar in this as in other respects. The absence of smoke is the natural result of the perfect combustion, as every minute particle of coal dust is completely burned in a proper installation. The intense heat obtainable by this coal dust jet will develop many special applications. One of the greatest advantages of this method of furnace firing is its adaptability to any grade of fuel, even coal that has no value on the grate bars. Anthracite, bituminous, lignite, coke breeze, all are grist to this sort of mill. Experts consider that coal with 45 per cent ash has no steam raising value whatever when burned in the old way, but Barmhurst has obtained profitable results with coal of 52 per cent ash in a coal dust jet. This method of firing makes possible a tremendous development of the low-grade coals of the West.

There are four simple requirements which absolutely must be obeyed:

First—The coal must be dried so that it contains not over one per cent of moisture.

Second—The coal must be pulverized to a high degree of fineness.

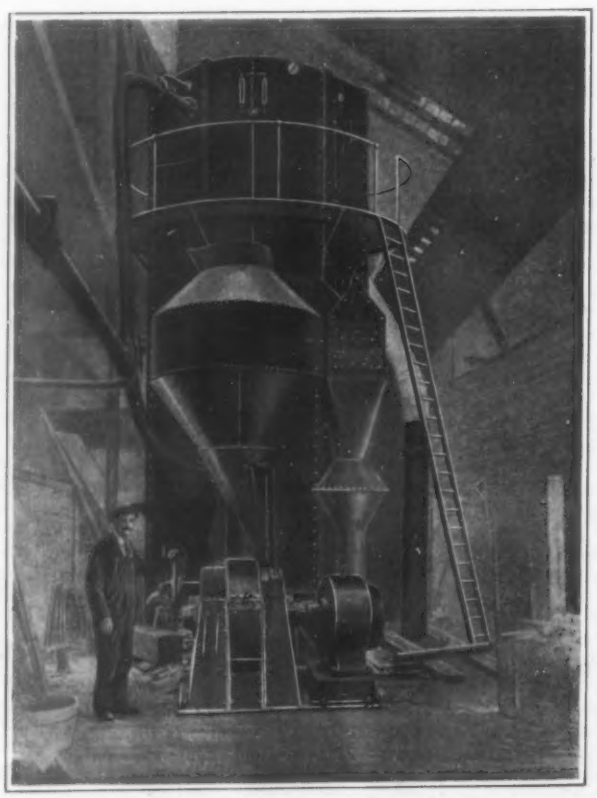
Third—It must be blown into a chamber hot enough to cause instant deflagration.

Fourth—It must be supplied with air sufficient to yield the oxygen necessary to burn the carbon of the coal at once to carbon dioxide.

Drying the coal is essential for two reasons. Coal containing much more than one per cent moisture is not easily ground to a fine powder. Furthermore, if this moisture were not removed in a drying oven it would be converted into superheated steam in the most expensive place for such energy consumption—the combustion chamber. This causes a very great loss in efficiency. Fine grinding is essential in order to increase the free surface of every pound of coal. Rapidity of combustion depends on this intimate contact of air and coal which is possible only with extremely minute particles. Very efficient grinding machines are on the market, producing any degree of fineness desired. Some engineers consider that if 85 per cent of the dust passes a screen of 100 meshes to the linear inch, that is, each mesh is 1/100 of an inch square, the combustion results by this method will be satisfactory. Others make more rigid requirements, insisting that 85 per cent should pass a screen of 200 meshes to the inch.

Barmhurst states that 85 per cent of the dust will pass a 400-mesh screen and fully 70 per cent a 600-mesh screen, when ground by the best machines. Considering that each particle is a cube 1/600 inch on edge he estimates that a cubic inch of coal may break up into 216,000,000 such grains of dust. The surface exposed to air by a block of coal one inch on a side is only 6 square inches, hence such a cube burns slowly. The surface of this same cubic inch in the finest powder exposed to air in an intimate mixture is 3,600 square inches. Rapidity and completeness of combustion in the latter case is to be expected.

Too great a velocity of the fuel mixture does not permit the coal to develop its heat near the point of ignition where it is most needed, that is, at the entrance of the coal into the combustion chamber. To insure perfect combustion every pound of carbon needs 2 2/3 pounds of oxygen, which is found in 154 cubic feet of air. If less air is supplied much of the carbon burns to carbon monoxide, which escapes from the stack or burns in the stack without benefit. To utilize all the energy of the fuel the carbon must burn to carbon dioxide in the combustion chamber. Because of the extremely high temperatures obtained with coal dust, excess air is usually admitted to cool the gases somewhat. From 50 to 100 per cent excess is common in the best practice. When one pound of carbon burns with exactly 2 2/3 pounds of oxygen combustion should be complete, and, theoretically, a temperature of 4,859 deg. Fahr. be obtained, but with 4 pounds of oxygen, or 50 per cent excess, only 3,326 deg. Fahr. should be obtained, and with 100 per cent excess only 2,529 deg. Fahr. The color of the flame is a guide to the stoker in regulating the amount of air required for maximum efficiency. A short white flame is the hottest. The furnace must be so designed that the fuel shall be thoroughly consumed before its resulting gases are brought in contact with the work to be done, otherwise particles of unburned carbon will be chilled and appear as smoke.



English type of boiler burning coarse coal dust.

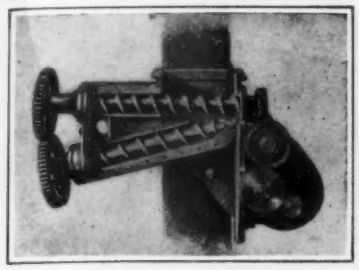
The process and machinery required are outlined by one of the best engineering companies as follows:

The coal is received in the pit of an elevator. This elevator carries it to the hopper of a pair of crushing rolls. Under this hopper may be an automatic weigh scale. From the hopper the fuel passes to an indirect fired coal drier. This drier must be of a size to deliver the required quantity continuously thoroughly dried. The drier is heated by a slow fire upon grates so arranged as to avoid igniting the drying coal. The cylinder of the drier is rotated by a small electric or steam motor. From the drier the coal drops into the pit of an elevator which carries it to a mill bin, set aloft. By spouts and gates the coal enters the pulverizer. By another elevator the fine dust is carried to the storage bins for powdered coal. These bins should hold enough to last during intervals that the pulverizer is not running. The coal is taken from the bottom of the bins by a worm feed screw, provided with a variable drive.

The feed screw delivers it into the burning pipe into which it falls. A fan forces a volume of air through the burning pipe, intimately mixing with the coal dust falling from the feed screw. The volume of air is easily controlled by either varying the fan speed, or by a blast gate.

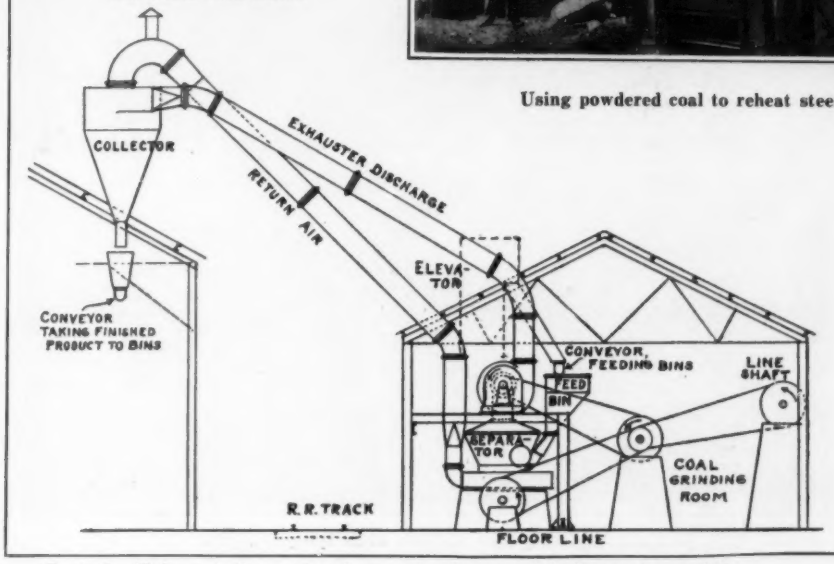
There is no danger of a coal dust explosion such as occurs in mines, for the air and coal dust are not mixed until just as they enter the furnace at high velocity. A "puff" cannot take place against this inrushing column of air and coal. The air is introduced before the coal is turned on, and the coal is shut off before the air. If coal is introduced faster than it will burn, a great quantity of gas is distilled and gives the effect of an explosion, quite harmless, however. When the hot gases impinge directly on firebrick a cooling system of water-cooled pipe set in the walls may be necessary to save the brick.

English practice in burning powdered coal differs somewhat from that used in America. The English favor a boiler, which uses rather coarse coal dust, containing up to 15 per cent moisture, for steam raising. Their practice is not to pulverize lump coal, but to utilize the screened dust from the mines, low in price, and reduce it to a powder not nearly so fine as that demanded by the American type. This pulveriz-

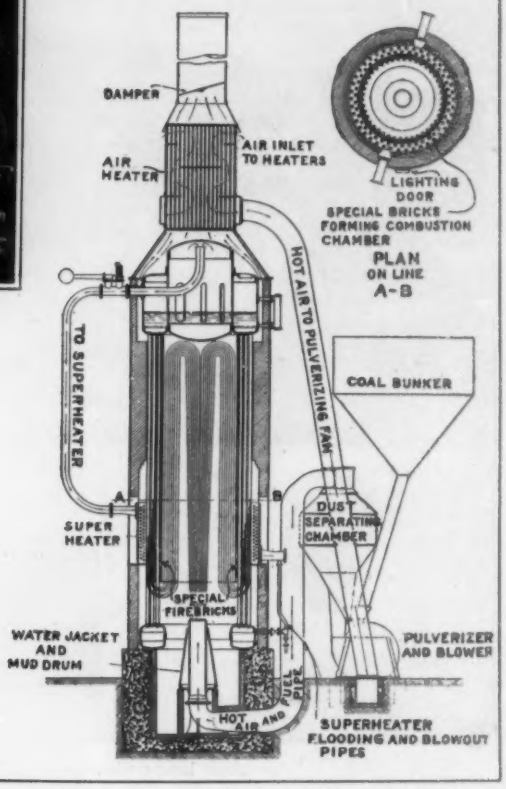


The worm feed screw.

Using powdered coal to reheat steel billets.



Typical mill for grinding coal and conveying it pneumatically to storage bins.



Cross section of the English type of boiler.

ing is done in a "beater" by fan blades of manganese steel at a speed of 1,500 revolutions per minute. Sufficient air is admitted in the beater for purposes of combustion. The fine particles are blown into the furnace through a nozzle. The coarser separate by gravity and are thrown back into the beater until reduced to the proper degree of fineness. There is no expense for drying unless the coal is above 15 per cent moisture.

The difficulties that delayed the development of a successful dust boiler are:

1. The difficulty of maintaining continuous and steady ignition, a difficulty met only by maintaining a uniform and very high temperature in the furnace.

2. The failure to find an economical material to stand the destructive temperature necessary as hitherto arranged for boiler firing.

3. The difficulty of producing a continuously homogeneous mixture with varying grades of coal, sometimes very wet and high in ash.

4. The difficulty of maintaining a homogeneous mixture of fuel dust and air during the full period required for complete combustion, the tendency of the larger solid particles being to concentrate in certain lines of direction, a difficulty met in part by extremely fine pulverization of the coal.

5. Difficulty of handling the molten ash which must usually form solid deposits of slag.

These troubles are overcome in the boiler here shown. It is of the vertical type and the tuyere is at the bottom, forcing the fuel dust and air with which it is mixed upward against the water tubes and brickwork at the top of the boiler. Thence the stream is turned down, enveloping the entering mixture with the highly heated products of combustion, and thus maintaining a regular ignition. The air mixed with the dust weighs about eleven and one half times as much as the coal and enters at considerable velocity. Since gravity and momentum act in the same direction in vertical firing there can be no separation of larger from smaller particles, a distinct advantage over horizontal firing. Of course the path of the particles is just great enough to permit the complete combustion of all the fuel. As in the American type it is necessary that the furnace be lined with brickwork of a highly resistant nature, not only to withstand the terrific temperatures, but to keep the fuel ignited by their incandescence.

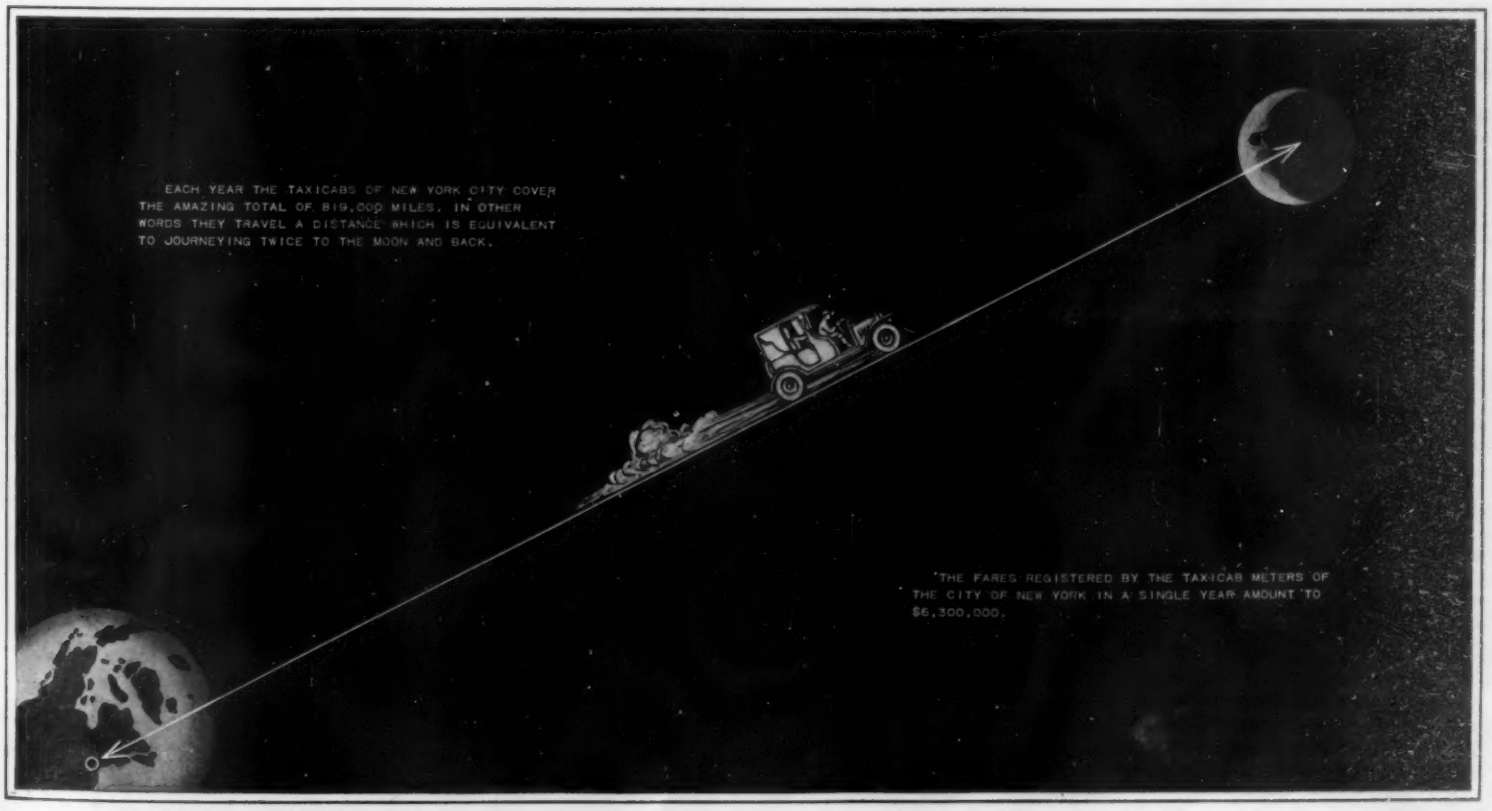
Boiler tubes are built into the fire brick and, since they are vertical and a rapid stream of water is circulated, they collect very little scale. This is mostly formed in the bottom header where it can easily be blown off.

The Taxicab Service of New York City

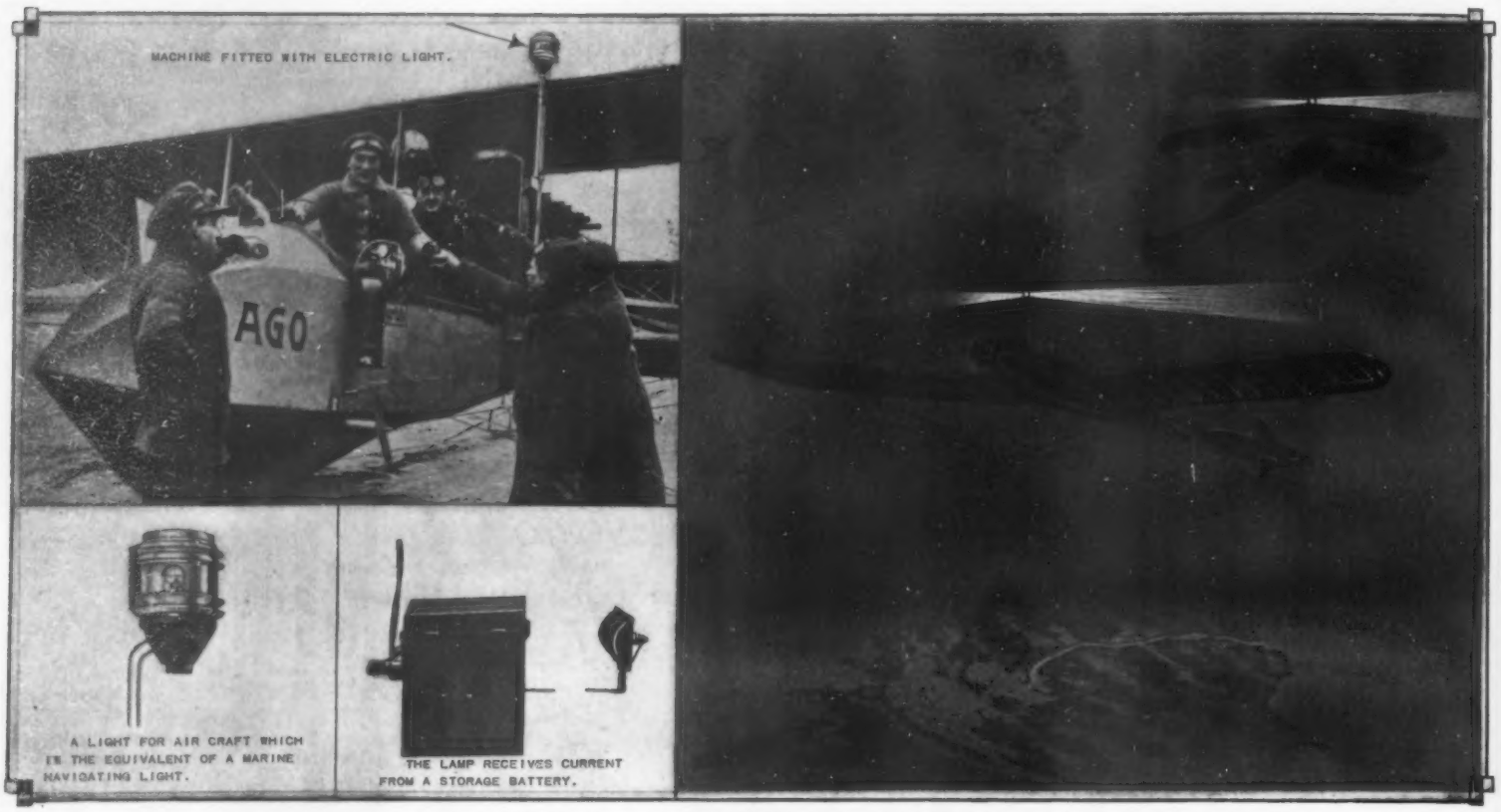
By Harry Chapin Plummer

TRULY magnificent distances are those compassed by Father Knickerbocker in that vehicle which is so characteristic of the twentieth century—the taxicab. There are three thousand of those restless, snorting, erratic conveyances in service in the streets of Greater New York, and, barring a limited area in the Borough of Brooklyn and isolated sections of the Bronx and Queens, they are mostly all concentrated in the district

(Concluded on page 336.)


EACH YEAR THE TAXICABS OF NEW YORK CITY COVER THE AMAZING TOTAL OF 819,000 MILES, IN OTHER WORDS THEY TRAVEL A DISTANCE WHICH IS EQUIVALENT TO JOURNEYING TWICE TO THE MOON AND BACK.
THE FARES REGISTERED BY THE TAXICAB METERS OF THE CITY OF NEW YORK IN A SINGLE YEAR AMOUNT TO $6,300,000.

If a single taxicab could do all the work of New York city's three thousand, it would make nearly two round trips to the moon in one year.


MACHINE FITTED WITH ELECTRIC LIGHT.
AGO
A LIGHT FOR AIR CRAFT WHICH IS THE EQUIVALENT OF A MARINE NAVIGATING LIGHT.
THE LAMP RECEIVES CURRENT FROM A STORAGE BATTERY.

Aeroplane lamps with lights of different colors, for showing their path and signaling their position when flying at night.

Aeroplane Lamps

A Light That Shows "Port" and "Starboard" and Also Throws White Beams Forward and to the Rear

By Dr. Alfred Gradenwitz

DIRIGIBLES are generally equipped with lamps fixed to the right and left, respectively, which, like those of ships on rivers or at sea, indicate the direction of traveling by red and green lights. In a similar manner, it would be desirable to fit aeroplanes with two lamps giving out lights of different colors, thus enabling their position on the ground and their path through the air to be signaled and collision with other air craft to be prevented.

A manufacturer in Berlin has designed a special aeroplane lantern which would seem to comply with all requirements to be satisfied by such lamps. While constituting no material extra load on the aeroplane and needing, under way, no attendance or supervision, it allows its position or direction of flight to be ascertained with all desirable accuracy.

This aeroplane lamp comprises a lantern casing inside of which there is arranged a 10 candle-power metal filament lamp whose light is so reinforced by an annular lens, that the luminous intensity actually given out amounts to about 40 Hefner candles. The lamp is plainly visible, even in foggy weather, to a distance of about three miles. Since the light is given out uniformly on all sides, the lamp is surrounded by a luminous ring. In order also to signal the direction of flight by means of this lamp, red and green glasses are so arranged in the interior of the annular lens that the forward portion of the luminous ring (about 10 degrees) appears white, whereas the adjoining part to the right (about 110 degrees) is colored green and the left-hand part of equal length, red. The rearward portion between the red and the green parts (about 130 degrees) again gives out a white light. This simple arrangement of the optical system enables any aeroplane equipped with the lamp to be sighted (and its direction of flight ascertained) at sufficient distance, the observer seeing more or less of the red or the green light beside the white.

The metal filament lamp is so designed that heavy shocks, as produced on landing, will exert no influence on it. Moreover, its fitting is carried by a substantial spring, damping any jerks.

The incandescent lamp is fed from an Edison accumulator, arranged close to the driver's or observer's seat, which complies with all requirements of the case. Replenishing with potash is only necessary every eight to twelve months, according to the actual strain on the accumulator. Refilling is effected exclusively with pure distilled water. Inclinations up to 45 degrees and heavy oscillations will not do any harm to the accumulator, nor will the electrolyte flow out. Recharging can be effected anywhere, the accumulator being readily removable.

It is recommended that the accumulator feeding the aeroplane lamp should feed at the same time a lighting plant for illuminating the instruments near the airman's seat, such as the speedometer, pressure gage, clock, gasoline gage, etc. A 2 candle-power incandescent lamp fitted with a reflector and red glass pane is sufficient; in this connection red light being preferable in order that the airman may not be dazzled.

Each charge of the Edison accumulator suffices for feeding the aeroplane lamp and instrument lighting plant during seven lighting hours. The current supply to the aeroplane and instrument lighting lamps, respectively, can be switched in separately from the airman's seat. Whenever required, a keyboard may be inserted into the aeroplane lamp circuit, thus allowing signals to be given by its aid.

The whole lighting plant of an aeroplane, as above described, weighs about 10 kilogrammes (22 pounds).

Military Aviation in France

FROM a recent discussion of French military aviation in the *Engineer* and *Le Temps* we gather that there has been a serious crisis in the French aeroplane industry, accompanied by a disorganization of the military aviation department, where the apparent absence of method, and the poor results obtained after the expenditure of huge sums of money, have given rise to severe criticisms in the Senate. In the past two years 677 aeroplanes were purchased, and of these 175 were paid for by public subscription. Nevertheless, it is widely admitted that the aviation corps is wanting in homogeneity and efficiency. A mistake was made in trying to centralize everything relating to the technical development of the aeroplane and dirigible balloon at Chalais-Meudon. This department was perhaps a little too exacting at a time when the construction of aeroplanes was not so well understood as it is at present. Having fixed a standard of its own, and being unable to get aeroplane manufacturers to build machines to a new specification, Chalais-Meudon embarked upon the construction of a special type of military aeroplane. A large number of machines purchased from private builders were broken up within a month or two of delivery on the ground that they were lacking in structural strength. It is true that this action seemed to be justified by the alarming number of fatal accidents that had happened to military pilots. Chalais-Meudon has certainly not done better. The Minister of War has therefore given particular prominence to the reforms which it is proposed to carry out, such as the decentralization of the military aviation department and the offering of encouragement to private makers to co-operate with the military authorities in the building of suitable types of military machines. The present tendency is to develop an armored aeroplane which, in the words of the Minister, will be an "aerial destroyer." Improvements in aeroplanes and the organization of the military service on a sound basis require so much undivided effort that it has been decided to separate the aeroplane from the dirigible balloon, to which much more attention will be given in the future. Instead of sacrificing one to the other, both will be developed independently. The French government is having plans prepared for rigid dirigibles of 30,000 cubic meter capacity.

A Technical Museum for New York

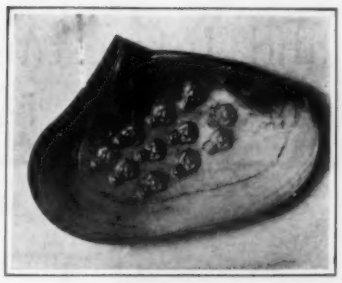
THE prospects that New York will have a museum comparable with the splendid Deutsches Museum of Munich are bright. It is announced that there will be established a group of twenty separate museums of as many industrial arts, to be known as the "Museums of Peaceful Arts." The proposed museums will cost $20,000,000, of which, it was said, the incorporators prospectively had already reason to count on about $1,500,000 as a nucleus. The objects of the corporation are given thus:

To establish and to maintain as a permanent and useful memorial of the century of peace and amity that has followed the signing of the Treaty of Ghent on Christmas Eve, 1814, in the city of New York, and for the people thereof, and for the benefit of the citizens of the State of New York and of the United States generally, buildings which shall be devoted to the housing and proper exposition of permanent exhibits in the following branches, among others, of the industrial and peaceful arts:

Electricity	Historic Records
Steam	Health and Hygiene
Astronomy and Navigation	Textiles
Safety Appliances	Ceramics and Clays
Aviation	Architecture
Mechanical Arts	Scenic Embellishment
Agriculture	Gardening
Mining	Roads and Road Building Materials
Labor	Commerce and Trade
Efficiency	Printing and Books

A Sacred Clam Shell

THE clever priests of China often insert tiny images of Buddha within the shells of a living clam, which are left undisturbed for about a year. At the expiration of that time the images are covered with mother of pearl to such an extent that they appear to have grown in this natural manner. The Chinese people hold these shells in great reverence, believing that Buddha dwells within them. However, should a Christian chance to look upon one of the shells, it has no further value to them, as its charm is supposed to have left it.



Images of Buddha coated with pearl.

Afloat on the Dead Sea.

First Aeroplane in Jerusalem

DURING the last few months the aeroplane has made its appearance in many strange places, not the least among these being the ancient city of Jerusalem. It was during his flight from Constantinople to Cairo that M. Bonnier, the French airman, passed over the Holy City in his monoplane, descending upon the historic plain of Rephaim, a short distance south of Jerusalem. It was on this plain that King David met and defeated the Philistines. Never, in modern times, was the city so excited. It poured out *en masse* to see the airman and his machine —Christians, Jews, and Moslems. Our photograph depicts the airman about to leave for Cairo. The Holy City may be seen on the extreme left and the Mount of Olives on the right.

The first aeroplane in Jerusalem.

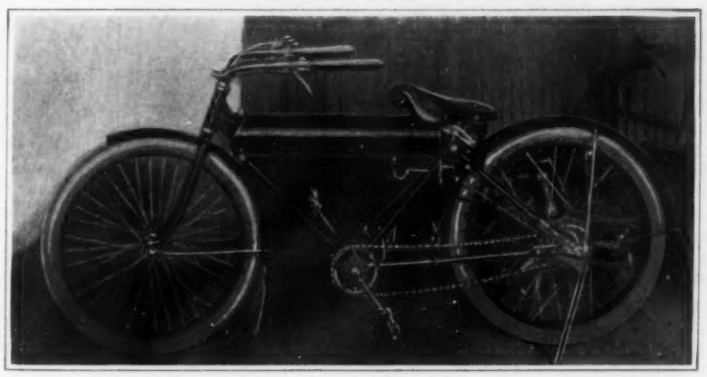
Revolving Cylinder Motor on a Motorcycle

THE revolving cylinder internal combustion motor, which failed so dismally on the single make of automobile on which it was used, but which since has "proved" itself in connection with the aeroplane, is due to have a tryout in motorcycle service. A machine mounting a three-cylinder motor of that type has been developed by a Connecticut inventor who now is completing arrangements to manufacture the machine in great numbers.

The motorcycle, which is pictured herewith, does not differ widely, exclusive of the motor, from accepted practice. The motor is mounted inside the rear wheel and concentric with it, so that the cylinders revolve in the same plane as the wheel. It is geared to the wheel by means of spur gearing, the ratio being four to one. In common with aeroplane motors of the same type, the carbureter supplies the mixture directly to the base chamber through a hollow shaft, whence it is admitted to the proper cylinder through the inlet valve, which is positioned in the piston and operated by means of a cam placed on the upper end of the connecting rod. The exhaust valves are in the heads of the respective cylinders, being operated by means of a stationary cam, tappets and tappet rods in the usual manner. Silence is approximated by causing the exhaust gases to pass through a series of comparatively small holes before emerging from the valve pocket. Ignition is effected by means of a set of batteries and a single coil operating in conjunction with a high tension distributer. While the maker claims that with a motor of this type it is perfectly possible to lubricate all parts by mixing the requisite amount of oil with the fuel, as is commonly done with two-cycle motors, for the present that system has not been adopted, and the oil is fed to the crankcase by means of a sight feed drip, and is circulated to the various parts by means of centrifugal force. A free engine clutch of the cone type serves to disconnect the engine from the wheel; it is operated by means of a lever on the handlebar.

The advantages claimed for the construction are manifold. Chief among them is light weight. The motor, which develops nine horse-power when run at normal speed, weighs about thirty-one pounds, and it is said that the motorcycle complete weighs fully a third less than any twin now on the market. Another big feature is the total absence of vibration, for the three radiating cylinders are perfectly balanced and there are no reciprocating parts with relation to the frame of the machine; hence the motor is perfectly balanced. In this connection, it is well to add that the intervals between the firing of the cylinders being equal, another reason for smooth operation and reduced vibration is evident. By the same token, the torque is more nearly constant and the motor can be throttled down and run slower than even the best regulated twin. Other features claimed are certainty of cooling, for the cylinders constantly cut the air, whether the motorcycle is moving or not, and the elimination of drive chains with their accompanying noise and dirt. The placing of the motor in such an out of the way position opens the way for the adoption of an open frame model for women riders.

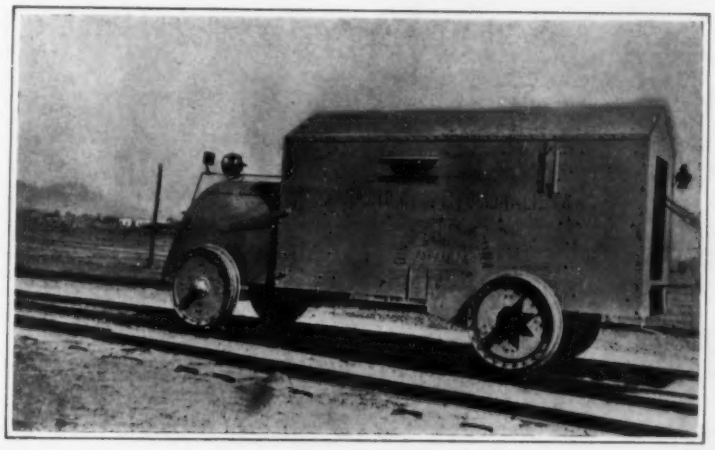
The apparent disadvantages of the type are inaccessibility of the vital parts, for the motor is closed in by the spokes; unequal distribution of weight, with the greatest amount on the rear wheel, tending to cause skidding; the delicate parts mounted where vibration is greatest and where there is no springing, which is not conducive to longevity. Whether the advantages gained will be sufficient to outweigh the disadvantages, time will tell.



Motorcycle fitted with a revolving cylinder motor.

Floating on the Dead Sea

THE wonderful buoyancy of the Dead Sea, that strange inland sheet of water in Palestine, is proverbial. It is some 47 miles long by 9 miles wide, and lies no less than 1,200 feet below the surface of the Mediterranean, the lowest-lying lake on the face of the globe. Its waters are so bitter that fish cannot live in them. We get an idea of its density when it is stated that in a ton of water from the Atlantic there is 31 pounds of salt against 187 pounds from a like quantity in the Dead Sea. The result is that it is impossible for a human being to sink in these waters, and the accompanying photograph depicts a tourist reading his guide book while floating on the surface of the water.

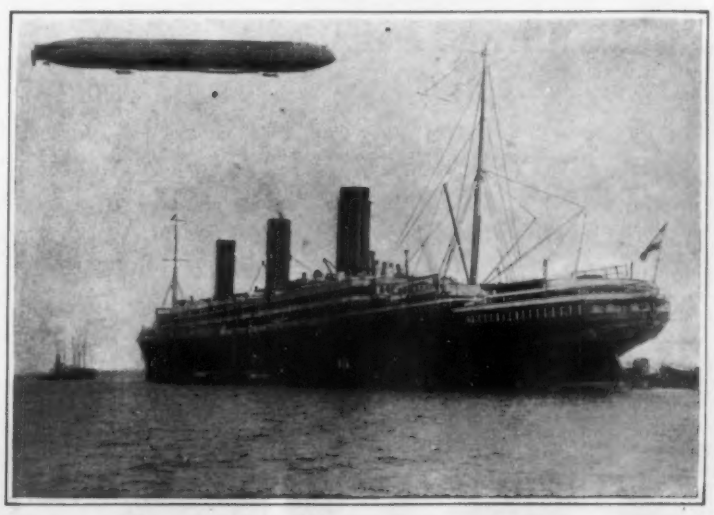


An armored motor car.

Mexican Armored Motor Car

THE accompanying photograph shows a standard American two-ton motor truck chassis which has been converted into a motor car by the Mexican Constitutionalists.

It was not known to what use the chassis was to be put when delivery was made to a southern dealer, but the result pictured is a striking reminder of the adaptability of the motor chassis, and shows the ingenuity displayed by the progressive Constitutionalists. Interior space of the armored body is used for carrying ammunition, rifles, etc., while the deadly fire of machine guns can be directed through small portholes in the walls. The car is fitted with armored wheels for operation upon the railroad, where a continuous stretch of track remains, or by quick adjustment the wheels can be changed to run over the roads directly into the *Zona Guerra*.



A giant of the sea and a giant of the air.

Two of the World's Seven Wonders

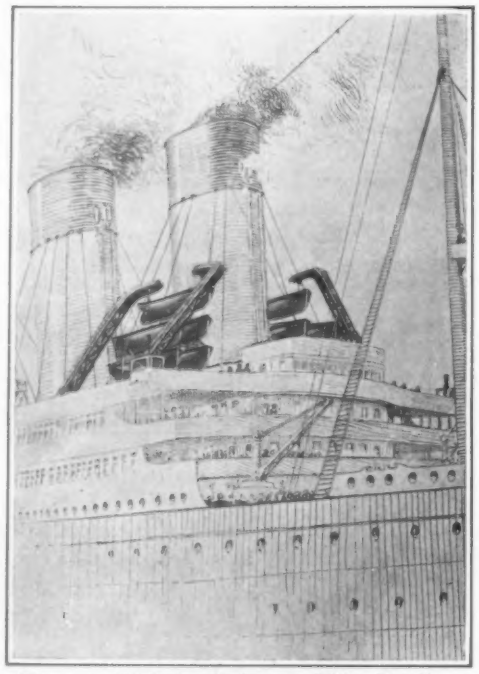
A SPIRITED voting contest has just been concluded in Germany to decide which are the seven wonders of the twentieth century. After the enormous volume of votes cast were counted, it was found that the majority had placed the wireless telegraphy at the head of the list and the Panama Canal second. The third of the seven wonders, it was decided, is the dirigible airship; next in order the flying machine, radium, the cinematograph, and the steamship "Imperator." An extraordinary photograph is reproduced herewith which shows two of the seven wonders of the modern world in close proximity. By a lucky chance the photographer has caught the dirigible airship "Hansa" and the "Imperator" on the same plate. The great airship, which measures more than 500 feet in length, was on one of her regular air cruises at the time she passed over the steamer.

Inventions New and Interesting

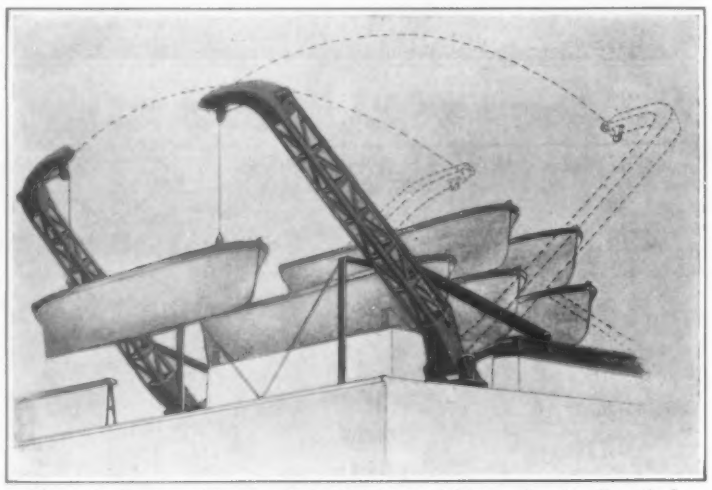
Simple Patent Law: Patent Office News; Notes on Trademarks

Lifeboat Arrangements on the "Britannic"

IT is certain that, up to within the last two or three years, the development of the lifeboat and its means for launching has lagged far behind the development of the ocean liner itself. To-day, however, a great deal of thought is being directed, not merely to the construction of the lifeboats themselves, but to the provision of strong and effective means for getting them quickly and safely overboard, even when they are loaded to their full capacity. We present two drawings which show the admirable way in which Harland & Wolff have worked out the problem on their new liner, the "Britannic," which will make her maiden trip to this port during the present year. The lifeboats are nested, two deep, in groups of five, and each group is served by a pair of powerful electrically-operated davits. The old boat davits have always seemed to us to be rather primitive affairs, lacking in the necessary strength and rigidity; but no such charge can be laid against the installation on the "Britannic." The main members of the davits are of stiff lattice work construction, hinged at the decks and capable of swinging through a wide arc. Each pair can be swung over so far inboard that it can pick up a lifeboat from the center of the ship and swing it out so far outboard that the risk of its being crushed against the ship's side is practically eliminated. Access to the boats is gained by stairways which lead to platforms running between the several tiers of boats, from which the passengers can step conveniently into place. These stairways and platforms are not shown in our illustration; but they are so arranged that the loading of the boats can be expeditiously done and without any confusion or crowding. The boat lowering gear is driven by electric motors of such power and so arranged that the lowering can be done very speedily, the boats being maintained on an even keel and released immediately on reaching the water.



The powerful davits of the new White Star liner "Britannic."



These davits can pick up a boat that is amidships and swing it entirely clear of a rolling ship.

A Smoke and Fume Monitor

By W. W. Strong

MANY furnaces are not placed so that the fireman can see the top of the smokestack. Neither does the manager of the power plant often see the black fuel issuing from the top of the stack. In other words, small account is given to this item of waste and the source of a fume and smoke nuisance in many cases.

Naturally a fireman is not careful about the part of his work to which no one pays any attention. The result is carelessness, and it is to this carelessness and lack of interest that much of the trouble of smoke inspectors is due. The purpose of the smoke monitor is to furnish an ever-present educational guide to the fireman, a conscience ever ready to prick at his contentment if he is not firing properly. The smoke monitor rings a bell and turns on a red light at the furnace door when the furnace is emitting smoke of a density forbidden by the city ordinance. The smoke monitor works day and night, and a recording mechanism can be attached to it. Besides the smoke monitor there should be a set of directions telling the fireman just what to do when the bell is ringing.

The smoke monitor is a very compact piece of apparatus, and is entirely electrical in its action. It uses from 60 to 100 watts of energy, and this is the only cost of maintenance, since there are no moving parts to the apparatus to get out of repair.

In the illustration the monitor is shown with all the parts together, though it is probably more convenient to place the bell *B*, the red lights *RL*, and the relay *R* by themselves, while the transformer *T* is placed near the stack. The transformer is a comparatively light one, giving about 20,000 volts potential (when on the 110 circuit) across the spark gaps *SG*. In parallel with this spark gap is a similar one placed in the smokestack. When there is little, if any, smoke in the stack the resistance is low and the discharge takes place in the stack. When smoke of a given density (say one third black) appears in the stack, the resistance is so increased that the discharge takes place at *SG*, and this discharge is a series of oscillatory sparks. The remainder of the apparatus consists of a coherer and relay and operates in the same way as in wireless telegraphy, turning on a bell and red lights whenever sparking takes place at *SG*. The apparatus can easily be carried about. There are few adjustments necessary, these being the proper setting of the spark gap electrodes, the relay and the coherer. When there is no smoke issuing from the furnace fires, the instrument is perfectly quiescent. As soon as smoke appears, the bell and red lights are turned on and remain going until the smoke ceases to be emitted. The relay could be made to operate any other similar device such as draft mechanism, steam jets, etc.

Instrument that sounds an alarm when a stack emits too much smoke.

Possibilities in Brush Invention

By H. M. Baxter

THE manufacture of brushes offers unlimited fields for the inventor, both in the production of a material to replace hog bristle, which is constantly growing more scarce and higher priced, and in the method of making the various sorts of paint, varnish, lather, hair, clothes and other brushes.

The following information regarding past efforts and present needs may be of assistance to any who wish to go into the matter.

Probably the most pressing need is for a rapid, inexpensive method of setting paint and varnish brushes. This setting or fastening must be absolutely impervious to the action of all liquids, including water, oils, alcohol, French spirits, turpentine, and the various distillations of coal oil, and should not necessitate the application of either heat or pressure. It should be adaptable to round, oval and flat brushes of all sizes and lengths.

The system of vulcanization is objectionable on account of its cost and because of the extreme heat required, which is naturally more or less injurious to the bristle. Furthermore, the vulcanizing process requires several days, delaying the manufacture.

Since the making of the first brush, a good setting has been striven for by all brush workmen and manufacturers. Most of these efforts have been to produce a cement that would dry, say, within twelve hours, or over night, and after drying, would resist the action of all liquids.

This result has been attained several times, but to make such a cement adaptable to present brush-making methods, it must remain in suspension, in an open, shallow pan, on the brush-maker's bench, throughout the working day, and so far there has been no single material which meets all these requirements.

Practically all bristle used in brush-making is produced in Russia, Germany, France, Siberia, and China. During the past five years there has been a steady increase in price with a corresponding scarcity in supply and depreciation in quality. Hair from horses' and cows' tails, various sorts of vegetable fibers from tropical trees, split quills from feathers, carefully tapered and prepared, and many other expedients, have been tried with little success, though many of them are used to adulterate the costly bristle.

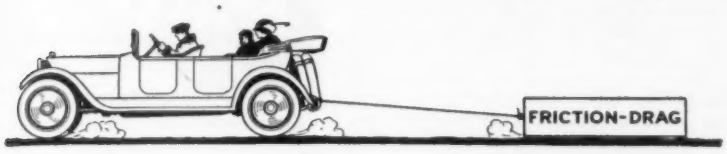
Some of the substitutes lack the requisite elasticity, others are too stiff and leave marks in the paint and varnish. And none of them possesses the marked "affinity" for oils and varnish that characterizes the hog bristle. Owing to its peculiar cellular formation and its natural oils, the "flag end" of bristle is a perfect paint and varnish smoother and distributer. This flag end consists of a tiny split or division into several parts of the outer end of the bristle, probably caused by the intense cold, in an endeavor to create a mat of warmth for the hog. Therefore, a substitute for hog bristle must have some sort of satisfactory spreading power, to correspond with the "flag end." It must possess great strength and elasticity, so as to carry and spread a heavy load of oil and lead paint, yet must be fine enough to not leave marks in the paint or varnish. It must also have, to some degree, the power to pick up, carry along, and discharge gradually, a heavy load of paint, which is the most marked and valuable characteristic of hog bristle, owing to its cellular construction and oily nature.

A Simple and Convenient Fish Rod

AN ingenious combination of a spring balance and fishing rod can be made without disturbing the general appearance of the rod. All that is needed is to hollow the end so as to make a regular tube, or else fit on a short piece of tube. Part way up the tube is attached a spring, and the lower end of the spring carries a short hook for hanging the fish. The weight of the fish thus draws down the end of the spring in the same way as in the usual spring balance, and by cutting a small window in one side of the tube, a scale can be put on a piece of glass fitted in the window, corresponding to a pointer attached to the spring. The whole is simply a spring balance, built into the end of the fishing rod, and it is all inclosed and not in the way at ordinary times.

"Give me a quart of oil"

This careless request may bring costly penalties



The garage man comes out.

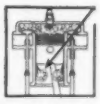
The motorist says, "Give me a quart of oil."

His "quart of oil" is poured into the crank-case or reservoir. The car goes on.

No doubt the motorist thinks he has amply protected the 1500-odd parts of his motor.

Far from it. *One of the surest ways to invite friction-drag and motor trouble is to say, "Give me a quart of oil."*

"Give me a quart of oil" invites Loss of Power

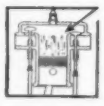


Escape of explosion past the piston rings, loss of compression and loss of power frequently result from oil of incorrect *body*. The power-loss is felt most on heavy roads and on the hills.

You can get full compression—complete power—only by using oil whose *body* suits *your* motor.

Correct *body* is seldom secured by saying, "Give me a quart of oil."

"Give me a quart of oil" invites Scored Cylinder Walls



Scoring frequently results from oil of low lubricating *quality*. Often, also, the oil's *body* is too light. Then the cylinder walls have no protecting film.

Scratching results.

Too often the blame can be traced straight to "Give me a quart of oil."

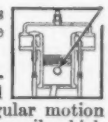
"Give me a quart of oil" invites Scored Cylinder Walls

The problem of bearing-lubrication is far from simple. Bearings differ widely in type and size. The oiling systems which supply them also differ. Adjustments vary.

Both the *quality* and *body* of the oil must suit these conditions. For every oil that suits your motor bearings, you will find many which will cause undue friction.

An almost sure start toward bearing-trouble is, "Give me a quart of oil."

"Give me a quart of oil" invites Wear of Wrist Pins

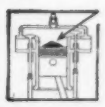


Wrist-pin lubrication is a difficult problem and little understood.

The location of the wrist-pins within the heated pistons and the slight angular motion of the bushings demand an oil which will spread readily, yet maintain the proper film between the pins and bushings.

Quick damage will come if the oil fails to meet these conditions. To encourage wrist-pin troubles prematurely, it is only necessary to say, "Give me a quart of oil."

"Give me a quart of oil" invites Carbon Deposit



Guesswork won't eliminate this trouble.

Both the *quality* and the *body* of the oil must be considered.

Suppose the *body* is too light for the piston clearance. The oil then works too freely into the combustion chambers. In burning, excess carbon accumulates unless the oil's ash is light and naturally expelled through the exhaust.

An easy road to carbon trouble is, "Give me a quart of oil."

"Give me a quart of oil" invites Noise

Noise is often a sign of worn parts—resulting from friction.

It may be a dull "thump" at every revolution of the main shaft. It may be "knocking" of worn wrist pins. It may be "hissing" within the cylinders. It may be "knocking" caused by excessive carbon deposit.

When a comparatively-new car pounds and racks its way along the roads it is seldom necessary to ask what brought on premature old age. Generally it is undue friction—resulting from incorrect lubricating oil. A way to invite premature noise is an off-hand request, "Give me a quart of oil."

"Give me a quart of oil" increases Maintenance Cost

If the oil's *quality* is low, a larger quantity is necessary to maintain a film.

If its *body* is incorrect, you have incomplete protection for the moving parts.

In either case excessive friction-drag results. Fewer miles are obtained from each gallon of gasoline. Your fuel and repair bills mount up.

This common waste is the frequent result of "Give me a quart of oil."

"Give me a quart of oil" reduces Second-Hand Value

What fixes the selling price of a used car? (1) The condition of the motor. (2) The condition of the chassis. (3) The condition of the body.

The motor is the vital part of the car. The motor condition, therefore, is most important.

At a recent sale in New York City, second-hand cars of uniformly prominent makes were auctioned off. The bodies were in good condition. The prices of the cars originally ranged from about $2000 to $5000. *The selling price in some cases was as low as $100.*

Why? Because the motors and other moving parts were badly worn.

Was the wear due to long service? No. The age of most of these cars disproved that. *Premature* wear was evident.

It is safe to say the owners of these cars had used the common expression—"Give me a quart of oil." They paid a high price for their carelessness.

How to secure the correct oil for your car

DO not say, "Give me a quart of oil."

You want an oil whose *body* is correct and whose *quality* is best suited to the requirements of your motor.

Ask for that oil and get it.

Below we print, in part, our Chart of Automobile Recommendations.

This Chart is the result of the most far-reaching and thorough study of automobile lubrication that has ever been made.

It was prepared by a company whose authority on scientific lubrication, for every class of machinery, is recognized throughout the world—The Vacuum Oil Company.

It was prepared after a careful analysis of the motor of each make and model of American and foreign car.

For a number of years this Chart has been the standard guide to correct automobile lubrication.

The superior efficiency of the oils specified has been thoroughly proven by practical tests.

Make a note of the grade of Gargoyle Mobiloil specified in this Chart for your car. Then make sure that you get it.

You will then give your motor oil of *body* and *quality* which will yield you the fullest power, the greatest freedom from friction, and the greatest pleasure in motoring.

If your car is not listed below, send for our *complete* Chart of Recommendations.

In buying Gargoyle Mobiloils, it is safest to purchase in original barrels, half barrels, and *sealed* five-gallon or one-gallon cans.

Look for the red Gargoyle on the container.

On request we will mail a pamphlet on the Lubrication of Automobile Engines. It describes in detail the common engine troubles—and gives their causes and remedies.

The various grades of Gargoyle Mobiloils, purified to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

They can be secured from reliable garages, automobile supply houses, hardware stores, and others who supply lubricants.

For information, kindly address any inquiry to our nearest office.

VACUUM OIL CO., Rochester, U.S.A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world

BRANCHES:

DETROIT, Ford Bldg. · BOSTON, 49 Federal St. · NEW YORK, 29 Broadway · CHICAGO, Fisher Bldg.
PHILADELPHIA, 4th & Chestnut Sts. · INDIANAPOLIS, Indiana Pythian Bldg. · MINNEAPOLIS, Plymouth Bldg. · PITTSBURGH, Fulton Bldg.

A guide to correct Automobile lubrication

Explanation: In the schedule, the letter opposite the car indicates the grade of Gargoyle Mobiloil that should be used. For example, "A" means "Gargoyle Mobiloil A." "Arc." means "Gargoyle Mobiloil Arctic." For all electric vehicles use Gargoyle Mobiloil "A." The recommendations cover both pleasure and commercial vehicles unless otherwise noted.

MODEL OF CARS	1910		1911		1912		1913		1914	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Abbott Detroit	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Alco	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
American	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Autocar (2 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
" (4 cyl.)	A	E	A	Arc.	A	Arc.	...	...	...	...
Avery	A	E	A	E	A	A	A	A	A	A
Buick (2 cyl.)	A	A	A	A	A	A	A	...	...	...
" (4 cyl.)	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Cadillac (4 cyl.)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Cartercar	A	E	A	E	A	E	A	E	Arc.	Arc.
" Com'l	A	E	A	Arc.	A	Arc.	A	Arc.	...	...
Case	...	...	A	A	A	Arc.	A	Arc.	A	Arc.
Chalmers	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	A	A
Chase	B	B	B	B	B	B	B	B	B	B
Cole	Arc.	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Delaunay-Belleville	B	A	B	A	B	A	B	A	B	A
E. M. F.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...	...	...
Fiat	A	A	B	A	A	A	B	A	B	A
Flanders	E	E	E	E	Arc.	Arc.	...	...	...	...
" (6 cyl.)	...	...	...	...	...	...	Arc.	Arc.	...	...
Ford	A	Arc.	E	E	E	E	E	E	E	E
Franklin	B	Arc.	A	Arc.	A	Arc.	A	Arc.	A	A
" Com'l	B	A	B	A	A	Arc.	A	Arc.	...	...
G. M. C.	...	...	...	...	Arc.	Arc.	A	Arc.	A	Arc.
Havers 6-44	...	...	A	Arc.	A	Arc.	A	Arc.	A	A
Havers 6-66	...	...	...	...	...	...	...	...	Arc.	Arc.
Haynes	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hudson	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Hupmobile "20"	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
" "32"	...	...	...	...	...	...	A	Arc.	A	Arc.
I. H. C. (air)	...	...	...	...	...	...	B	A	B	A
" (water)	...	...	...	...	...	...	A	A	A	A
International	B	A	B	B	B	A	...	...	...	...
Interstate	A	E	A	Arc.	A	Arc.	A	Arc.	...	...
Jackson (2 cyl.)	A	A	...	...	...	...	...	...	...	...
" (4 cyl.)	A	Arc.	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Jeffery	...	...	...	...	...	...	...	...	A	A
Kelly	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	A

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MODEL OF CARS	1910		1911		1912		1913		1914	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
King	...	...	A	E	A	E	A	E	A	A
Kline Kar	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Knox	B	A	B	A	B	A	B	A	B	A
Krit	A	A	A	A	A	A	A	A	A	A
Locomobile	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Lozier	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Mack	A	E	A	E	E	E	E	E	A	A
Mack, Jr.	...	...	...	...	...	...	...	...	A	Arc.
Marion	...	...	A	E	A	E	A	Arc.	A	Arc.
Marmon	A	E	A	E	A	Arc.	A	Arc.	A	Arc.
Maxwell (2 cyl.)	E	E	E	E	E	E	E	...	...	...
" (4 cyl.)	E	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
" (6 cyl.)	...	...	...	...	...	...	Arc.	Arc.	Arc.	Arc.
Mercer	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.

MODEL OF CARS	1910		1911		1912		1913		1914	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Mitchell	Arc.	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Moline	A	E	A	Arc.	A	Arc.	A	Arc.	...	...
Moline Knight	...	...	...	...	...	...	...	...	A	A
Moon (4 cyl.)	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Moon (6 cyl.)	...	...	...	...	...	...	...	...	Arc.	Arc.
National	A	A	A	A	A	A	A	A	A	A
Oakland	A	E	A	Arc.	A	Arc.	A	Arc.	Arc.	Arc.
Oldsmobile	A	E	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
Overland	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Packard	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	A	Arc.
Paige Detroit	E	E	A	Arc.	A	E	A	E	A	A
Pathfinder	...	...	...	...	...	A	Arc.	Arc.	Arc.	Arc.
Peerless	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pierce Arrow	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" " Com'l	...	...	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Pope Hartford	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Premier	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Rambler	A	A	A	Arc.	Arc.	Arc.	Arc.	Arc.	...	...
Regal	A	E	A	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Renault	A	Arc.	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Reo	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
S. G. V.	...	...	B	Arc.	B	Arc.	B	Arc.	A	Arc.
Selden	A	E	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Simplex	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Speedwell	Arc.	Arc.	A	Arc.	A	Arc.	Arc.	Arc.	Arc.	Arc.
" "Mead"	...	...	...	...	...	A	Arc.	B	A	...
Stearns	Arc.	Arc.	A	Arc.	A	Arc.	...	...	...	...
" "Knight"	...	...	...	...	A	A	A	A	A	A
Stevens Duryea	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Stoddard-Dayton	Arc.	Arc.	A	A	A	A	A	A	...	...
" "Knight"	...	...	...	...	A	A	A	A	...	...
Studebaker	E	E	A	Arc.	Arc.	Arc.	A	Arc.	A	Arc.
Stutz	...	...	...	...	A	A	A	A	A	A
Velie 9-45	A	E	A	Arc.	A	Arc.	A	Arc.	A	Arc.
Velie 9-50	...	...	...	...	...	...	...	...	Arc.	Arc.
Walter	A	E	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
White (Gas)	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.
Winton	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.	Arc.

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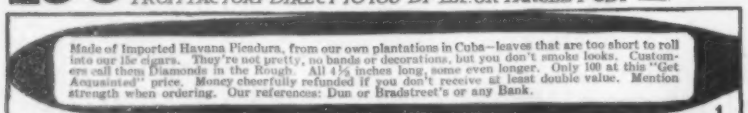

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The Taxicab Service of New York City

(Concluded from page 331.)

of Manhattan Borough whereof Times Square is the focal point. To utter the word "Taxi" in the vicinity of Times Square is to bring one of the gay-colored autocabs throbbing and pulsating before one at the curb.

The active season for taxicab service extends through about seventy-five per cent, or nine months of the year, but in that time the meters register the amazing total of 819,000 miles, almost four times the distance from the earth to the moon, which astronomers tell us is 221,000 miles in its nearest position. So Father Knickerbocker, seated in his fairly comfortable, if somewhat inelegant, taxicab, accomplishes yearly almost the equivalent of two round trips to the moon.

When the immensity of this mileage is taken into consideration, the physical capital which the industry in New York city alone represents and the earnings accomplished thereby seem relatively trifling. For $2,000 each would be a high valuation to place upon all of the taxicabs in service in the Greater City. Many vehicles are at the beck and call of patrons which have been condemned by the larger operating corporations and are valued in the open market at as low as $100; yet this average would mean a total valuation of no more than $6,000,000.

The most liberal estimate of the earnings of the taxicabs of New York would be $2,800 per year for the 75 per cent of the total number of machines operating throughout the year, and this would give an aggregate of gross earnings of $6,300,000.

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A SERIES of ten comprehensive articles on the present condition of our Navy, showing its unpreparedness, its present rating among the navies of the world, and what must be done to bring it up to its proper strength and position are being published consecutively in the SCIENTIFIC AMERICAN.

Seven articles of this series have appeared in the issues of February 28th, March 7th, March 14th, March 21st, March 28th, April 4th, and April 11th, on the following subjects:

No. 1—"How the Navy is Daily Employed," by Hon. Franklin D. Roosevelt, Assistant Secretary of the Navy.

No. 2—"Sea Power and Our Foreign Policy."

No. 3—"The Decline of the United States Navy to Third-Class Rank."

No. 4—"The Price We Pay for Self-Sufficiency and Unpreparedness."

No. 5—"Battleship Strength Necessary to Guarantee Peace."

No. 6—"The Shortage of Scouts, Torpedoes and Mines."

No. 7—"The Shortage of Officers and Men."

The eighth article appears in this issue.

No. 8—"The Need of a System of Rapid Mobilization."

Next week will be published:

No. 9—"The Need of a Council of National Defense."

The tenth and concluding article, written especially for this series, "The Navy is Not an Economic Waste," by Hon. Josephus Daniels, Secretary of the Navy.

Nelson's Tactics at Trafalgar are the subject of a recent report to the British Admiralty by a committee appointed to investigate the long-mooted question as to whether the plan of attack prepared by the great commander about a fortnight before the battle and communicated at that time to his captains was adhered to, or whether at the last moment a totally different plan was adopted, more or less by accident. The importance of this question consists in the fact that ultra-practical naval officers are prone to cite Nelson's alleged abandonment of his elaborate plan as an argument against naval tactics in general, claiming that in the heat of action tactics are forgotten. The report demonstrates beyond dispute that the plan drawn up on October 9th was carried out on October 21st in all essential respects.

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Inquiry No. 9368. Wanted, the name and address of glass-bottle manufacturers or glass blowers who can manufacture a glass bottle and perforate it with some 12 small holes, in large quantities for export, to sell at a popular price.

Inquiry No. 9369. Wanted, the names and addresses of users of Indian Steatite (Soapstone), Corundum and other Indian minerals, in quantities.

Inquiry No. 9370. Wanted the names and addressess of manufacturers of small wooden articles, particularly in such soft woods as pine and fir, for articles such as toys, furniture, etc.

Inquiry No. 9371. Information wanted where one could buy or have made to order machine to be used for making solid back brushes.

Inquiry No. 9372. Wanted the name and address of manufacturers of a collapsible box about 12 inches square. It must be strongly made to withstand rough usage in transit.

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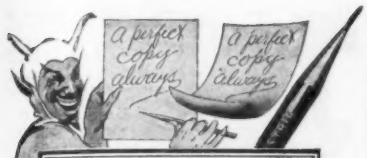

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Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12977) E. M. B. asks: Are astronomers of the opinion that the telescope has attained its fullest scope? Do they think its power can be continually enlarged, so that after a while it may be possible to observe whether or not some nearby (relatively speaking) planet is inhabited? Or, as stated above, possibly the field of the telescope is limited, due perhaps to the molecular nature of glass (if glass can be said to be composed of molecules). A. The telescope is limited, but not because of the nature of glass. One limitation is in the Earth's atmosphere itself. There are few nights when the highest powers can be used at all. The air is not sufficiently quiet and of uniform temperature. Other limitations are in the mechanical difficulties presented by large and heavy tubes, mounted to swing high in air, in the bending of large disks of glass suspended only by the edges, and the great increase in cost as the size is increased. The disks of glass from which the 40-inch objective of the Yerkes telescope was made, weighed over a ton and cost $20,000. Many astronomers think that the limit in size of telescopes has already been reached.

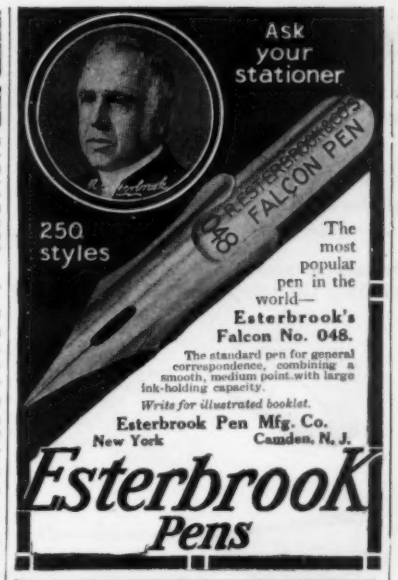
(12978) F. J. C. asks: Will you please tell me what is, or about, the voltage given off by an ordinary jump spark coil when wired to a set of new batteries, say testing 6 volts and 20 amperes? A. The voltage required to send a spark through air between sharp points is about as follows: For a half inch, about 12,000 volts; for one inch, about 20,000 volts; for 1½ inches, about 28,000 volts.

(12979) L. P. asks: I ask your opinion or interpretation of the following, which is said to have been taken from an old work said to have been written in Egypt: "Make a magnet of the plusquam-perfection accompanied by the *prime material* of which all *metals grow*, and with this the magnet of the compass can be strengthened." What is plusquam-perfection (if anything) and what is the prime material of which all metals grow? A. The word "plusquam" is a Latin word, and means "more than." Applied to a magnet it should mean a supersaturated magnet, which will not retain all its magnetism. We doubt if the Egyptians knew anything about such magnets. There is no "prime material" from which all metals grow. That is an old notion of the alchemists. When the compass needle has been saturated, any further magnetizing is of no account. The needle will drop back to its ordinary strength as soon as the extra force is taken away from its vicinity.

(12980) S. A. W. asks: I want information concerning what I believe is called "Fermat's theorem." It is:

$$x^{n+1} + y^{n+1} = z^{n+1}$$

when n is a positive integer. About a year ago, I read in the SCIENTIFIC AMERICAN that a large prize had been offered for a solution. I have a partial proof which I wish to submit. A. A prize of 100,000 marks (about $25,000) is offered by the Academy of Sciences of Goettingen for the proof of the greater Fermat theorem. Fermat stated that the equation $x^n + y^n = z^n$ could not be satisfied by whole numbers when n is an odd prime number. This is the theorem to be proved to win the prize. We receive so many inquiries about this very attractive offer that we will state the conditions made by the Academy of Sciences for winning the prize: It will not consider any manuscripts sent to it in competition for the prize, but will consider all memoirs which appear in the mathematical periodicals, or which are for sale in the book trade as monographs or as books. The Academy requests the authors of such memoirs to send it five printed copies. Memoirs in languages unknown to the judges must be accompanied by authentic translations. The award will not be made earlier than two years after the publication of the memoir for which it is awarded. The award cannot be contested. During the two years, opportunity will be given to mathematicians to express an opinion upon the correctness of the solution selected, which will be made public. These are the principal regulations for the award. It is evident that only a complete mathematical solution may be offered. No partial solution will be considered. No one can send in a manuscript for the contest. A printed copy only will be received, published by some book house or in a mathematical periodical, which means that the solution must commend itself to some competent editor, or to a publisher as likely to be a profitable investment, in the first place. It must then meet the criticism of the mathematical world for two years after the Academy has approved of it. The Academy does not intend to be flooded with manuscripts which have not been endorsed by any one of prominence in the mathematical world. We trust that all our correspondents will note these points. They are abstracted from the offer of the prize in the *Bulletin* of the American Mathematical Society, October, 1908, pages 44–45. Also in the same periodical for November, 1907, page 92. We are indebted for this information to Dr. Joseph Bowden, Professor of Mathematics, Adelphi College, Brooklyn, N. Y.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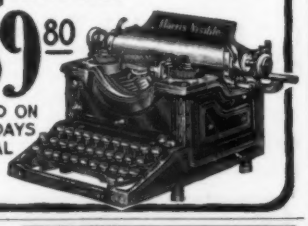

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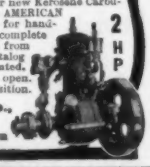

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Also Bowser underground systems and tanks on wheels for the commercial garage.

In Stores

Keep kerosene, paint, lubricating oils, etc.—safe from changeable temperature, fire, theft, and away from other merchandise. No loss. No hazard. No spoiled merchandise. No groping for oil in the dark

In Factories

From simple departmental oil storage units to large filtering and circulating systems. Compel accuracy and efficiency. Check and use every drop of oil. Bowser Systems enable you to use the same oil over and over again.

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Put your oil storage problems up to Bowser—whether of garage, store or factory. Bowser has been solving just such problems for over twenty-nine years. Ask questions. Costs nothing to find out. No obligation. Learn the added efficiency, the economy, the safety, the *comfort* and utility of Bowser service. Send the coupon today—NOW.

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Unseen Forces Behind Your Telephone

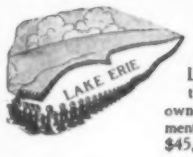
THE telephone instrument is a common sight, but it affords no idea of the magnitude of the mechanical equipment by which it is made effective.

To give you some conception of the great number of persons and the enormous quantity of materials required to maintain an always-efficient service, various comparisons are here presented.

The cost of these materials unassembled is only 45% of the cost of constructing the telephone plant.

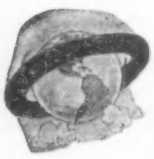
Poles

enough to build a stockade around California—12,400,000 of them, worth in the lumber yard about $40,000,000.



Telephones

enough to string around Lake Erie—8,000,000 of them. 5,000,000 Bell owned, which, with equipment, cost at the factory $45,000,000.



Wire

to coil around the earth 621 times—15,460,000 miles of it, worth about $100,000,000, including 260,000 tons of copper, worth $88,000,000.

Switchboards

in a line would extend thirty-six miles—55,000 of them, which cost, unassembled, $90,000,000.

Lead and Tin

to load 6,600 coal cars—being 659,960,000 pounds, worth more than $37,000,000.

Buildings

sufficient to house a city of 150,000—more than a thousand buildings, which, unfurnished, and without land, cost $44,000,000.

Conduits

to go five times through the earth from pole to pole—225,778,000 feet, worth in the warehouse $9,000,000.

People

equal in numbers to the entire population of Wyoming—150,000 Bell System employees, not including those of connecting companies.

The poles are set all over this country, and strung with wires and cables; the conduits are buried under the great cities; the telephones are installed in separate homes and offices; the switchboards housed, connected and supplemented with other machinery, and the whole Bell System kept in running order so that each subscriber may talk at any time, anywhere.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

NEW BOOKS, ETC.

THE CAUSE OF THE SOCIAL EVIL AND THE REMEDY. By Albert W. Elliott, President and General Manager the Southern Rescue Mission. Atlanta, Ga.: Webb & Vary Company, 1914. 16mo.; 144 pp.

In so far as this book deals with actual conditions and personal observations it is well worth a careful reading. The author's experiences have led him from the belief that the remedy lies in legal suppression, or even in reformation, through a dawning conviction that social vice is more a matter of the well-to-do and "respectable" classes than a mere problem of the underworld; until at length he sees that the fundamental causes must be sought elsewhere than in economic conditions. The weakest portion of the work is that dealing with "the remedy." The author himself seems to realize his helplessness here, for he is converted to the theory of toleration, though not of license, and he leaves the problem substantially as he finds it.

ELECTRIC LIGHT AND MOTOR WIRING. By George J. Kirchgasser. Milwaukee, Wis.: Electroforce Publishing Company, 1914. Price, $1.

This is a book small enough to fit into the vest pocket, yet containing a great deal of up-to-date information on ordinary wiring. The National Electric Code requirements are cited, different systems are described in detail, and the illustrations and diagrams average at least one to a page.

THE ORIGIN OF EARTHQUAKES. By Charles Davison, Sc.D., F.G.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

In a small compass, the author has explained earthquake phenomena, earthquakes and the growth of faults, discussed some simple earthquakes and their origin, as well as twin earthquakes and their origin, complex earthquakes and their origin, illuminated the subject of fore and after shocks, discussed sympathetic earthquakes and their origin, as well as earthquake sounds and their origin, and thus given the reader interested in popular science a good *résumé* of modern seismology.

LINKS WITH THE PAST IN THE PLANT WORLD. By A. C. Seward, M.A., F.R.S., Professor of Botany in the University of Cambridge. Cambridge: The University Press. New York: G. P. Putnam's Sons.

In this book, the reader who seeks only the facts of an important science presented in a popular way will find a very readable account of the botany of the present compared with the botany of the past. The subject is one which is fascinating, one which has a wide popular appeal. It lends itself admirably to presentation in simple form. Prof. Seward has made the most of his opportunities.

THE MIGRATION OF BIRDS. By T. A. Coward. Cambridge: The University Press. New York: G. P. Putnam's Sons.

In this popular book will be found the more important theories on the migration of birds and a discussion of speculations and evidence. The subject is a controversial one. Almost every student of bird flight has his own views. While, therefore, it is very difficult to write impartially, we believe that Mr. Coward has acquitted himself very creditably.

AN INTRODUCTION TO EXPERIMENTAL PSYCHOLOGY. By Charles S. Myers, M.D., Fe.G., Lecturer in Experimental Psychology at the University of Cambridge. Cambridge: The University Press. New York: G. P. Putnam's Sons.

The author has selected various topics which may be considered fairly typical themes of research in experimental psychology, such, for example, as color-vision, touch, temperature, the Mueller-Lyer illusion, experimental aesthetics, memory, mental tests and their uses; and these he has presented in such a form as will give the educated reader a general notion of the scope of the science and of the experimental methods it employs.

THE NATURAL HISTORY OF CLAY. By Alfred D. Searle. Cambridge: The University Press. New York: G. P. Putnam's Sons.

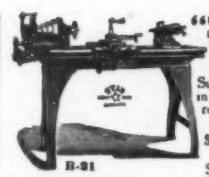
Mr. Searle has stated, in a simple form, an outline of present knowledge of the subject of clay, and has indicated the problems which still lie before the clay worker. First he discusses the chemical and physical properties of clay and then passes on to clay and associate rocks, the origin of clays, the modes of accumulation of clays, some clays of commercial importance, and clay substances; theoretical and actual. A good bibliography and index concludes the book.

THE WANDERINGS OF PEOPLES. By A. C. Haddon, Fe.D., F.R.S., Cambridge: The University Press. New York: G. P. Putnam's Sons.

This book is a brief survey, written in popular language, of the trend of human migrations so far as present knowledge permits. The author has covered various periods of human history, even going as far back as the earliest diffusions that can be predicated.

THE WORK OF RAIN AND RIVERS. By T. G. Bonney, F.R.S. Cambridge: The University Press. New York: G. P. Putnam's Sons.

In this book, persons of ordinary education will find all that they need to know of this interesting subject. The use of technical terms has been avoided, as well as the discussion of controversial points.



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Cadillac
Standard of the World

How much should an automobile weigh?

Suppose that railroads should offer you, as an inducement to trust your life in their hands, the argument that the weight of their rolling stock had been reduced to the lowest notch.

Suppose in the locomotive, they make the boiler wall so thin and so light, that it will barely withstand the normal pressure for a limited time.

Suppose they make the trucks, the wheels, and the axles barely strong enough to support the engine under the most favorable conditions.

Suppose they make the connecting rods barely strong enough to turn the wheels.

Then, going back to the cars, suppose they make the trucks, the wheels and the axles no stronger than just enough to carry them a few thousand miles.

Suppose they make the frame barely strong enough to support the body of the car.

Suppose they make the body barely strong enough to hold together.

Suppose they reduce the weight of every vital part to the lowest point.

Would you trust your life in the hands of a railroad which offered you such inducements?

Safety demands strength.

Strength demands material.

Material means weight.

If these be true, then:—

Absence of weight must mean absence of material.

Absence of material must mean absence of strength.

Absence of strength must mean absence of safety.

These things apply, whether you have in mind railroads or automobiles.

How much is your safety worth?

Cadillac materials are selected for their adaptability and fitness for the functions and duties which they must perform.

The designs of the various parts are adopted only after they have proven themselves to embody liberal factors of safety.

The Cadillac car will appeal to you because of its strength and its security, rather than upon the basis of lightness.

The Cadillac will appeal to you for its comfort as the luxurious Pullman appeals to you in contrast with the light weight flimsy coach.

The Cadillac will appeal to you for its smoothness and steadiness in running, as the majestic liner is in contrast with the light weight barque in a choppy sea.

The Cadillac will appeal to you because of its sturdiness and its endurance, rather than upon the basis of fragility and impermanence.

Because of its strength, because of its enduring qualities, the Cadillac is an economical car to own and to operate, day-in-and-day-out and year-in-and-year-out.

The Cadillac is economical in fuel.

Hundreds of 1914 Cadillac users are averaging from 15 to 18 miles per gallon of gasoline in every-day service.

Special test runs have been made showing more than 22 miles per gallon, but this cannot be taken as a criterion for the average user.

In the recent test by the Royal Automobile Club of Great Britain, which won for the Cadillac the Dewar Trophy, the 1914 car averaged 17.17 miles per gallon for 1000 miles over give-and-take roads—in spite of frequent stops and starts in testing the electrical cranking device.

It consumed less than one gallon of lubricating oil in traveling the 1000 miles.

Hundreds of users are averaging more than 5000 miles on tires. Some users are reporting from 6000 to 8000 miles and even more.

We believe that in tires, fuel and oil, the 1914 Cadillac will average more mileage than any car which approaches its efficiency.

Because of its standardization, because of the interchangeability of its parts, because of its sturdiness, because of its endurance, the Cadillac has been called The Everlasting Car.

That this appellation is merited, we need but point to the 75,000 Cadillacs produced, all of which to the best of our knowledge are still doing duty, the oldest after eleven years of service—and many of them after having passed the 100,000 mile mark.

How much should an automobile weigh?

It should weigh enough to enable it successfully to perform the duties required of it.

It should weigh enough to enable it successfully to perform those duties day-in-and-day-out and year-in-and-year-out, at a minimum outlay for operation and maintenance,—performance and satisfaction considered,—and with a minimum depreciation in value after years of service.

Cadillac Motor Car Co. Detroit, Mich.

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